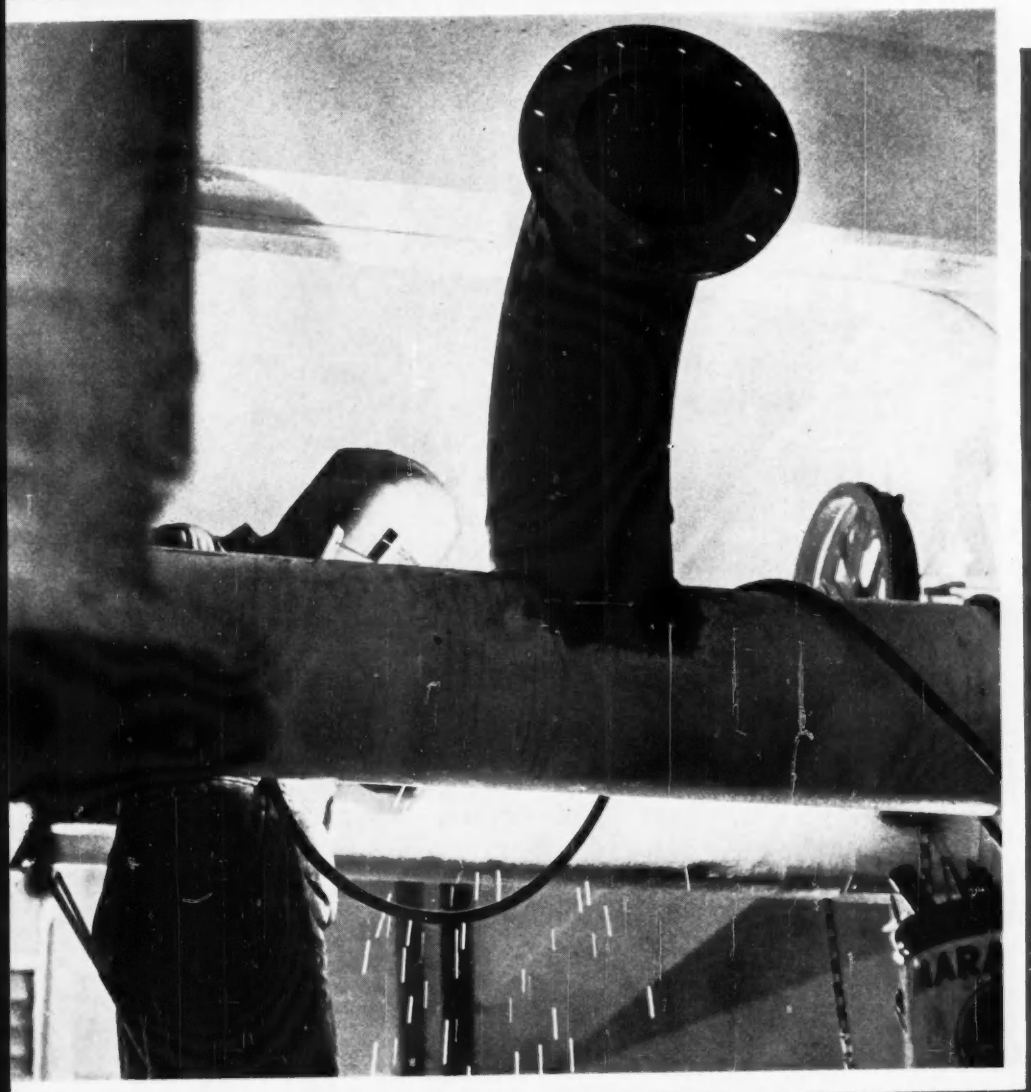
# Compressed Air Magazine



**NOVEMBER 1961**

IN THIS ISSUE:
- MAKING PAPER STICKY
- SCHEDULING DOWN TIME
- REVIEWING BALLOONING
- LUBRICATING ROCK DRILLS
- LAYING UP VENEERS

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COMPRESSED AIR MAGAZINE
PHILLIPSBURG, N.J.

EIMCO 126 FRONT END LOADER
WITH GRIZZLY-BOTTOM BUCKET

Harold Whiting

Mel Haymond

## "HOW COME YOU'VE NEVER TOLD HOW GREAT YOUR EIMCO LOADER REALLY IS?" . . . *Ask Whiting & Haymond Springville, Utah.*

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We've tried to give you the facts on the brawny, tough Eimco loaders and dozers but admit it **is** difficult to describe the productivity, maneuverability, design features and finely crafted, heavy-duty construction that sets any Eimco apart from the rest.

The most convincing way to learn about unique Eimco features and quality is to test and operate an Eimco yourself. We suggest you contact your nearby Eimco dealer or branch and arrange for a demonstration. As Whiting and Haymond Construction Company discovered, an Eimco sells itself best on the job . . . the tougher the job the better.

Write to The Eimco Corporation, Salt Lake City 10, Utah, U.S.A. for the name of your Eimco dealer and for Bulletin L-1174.

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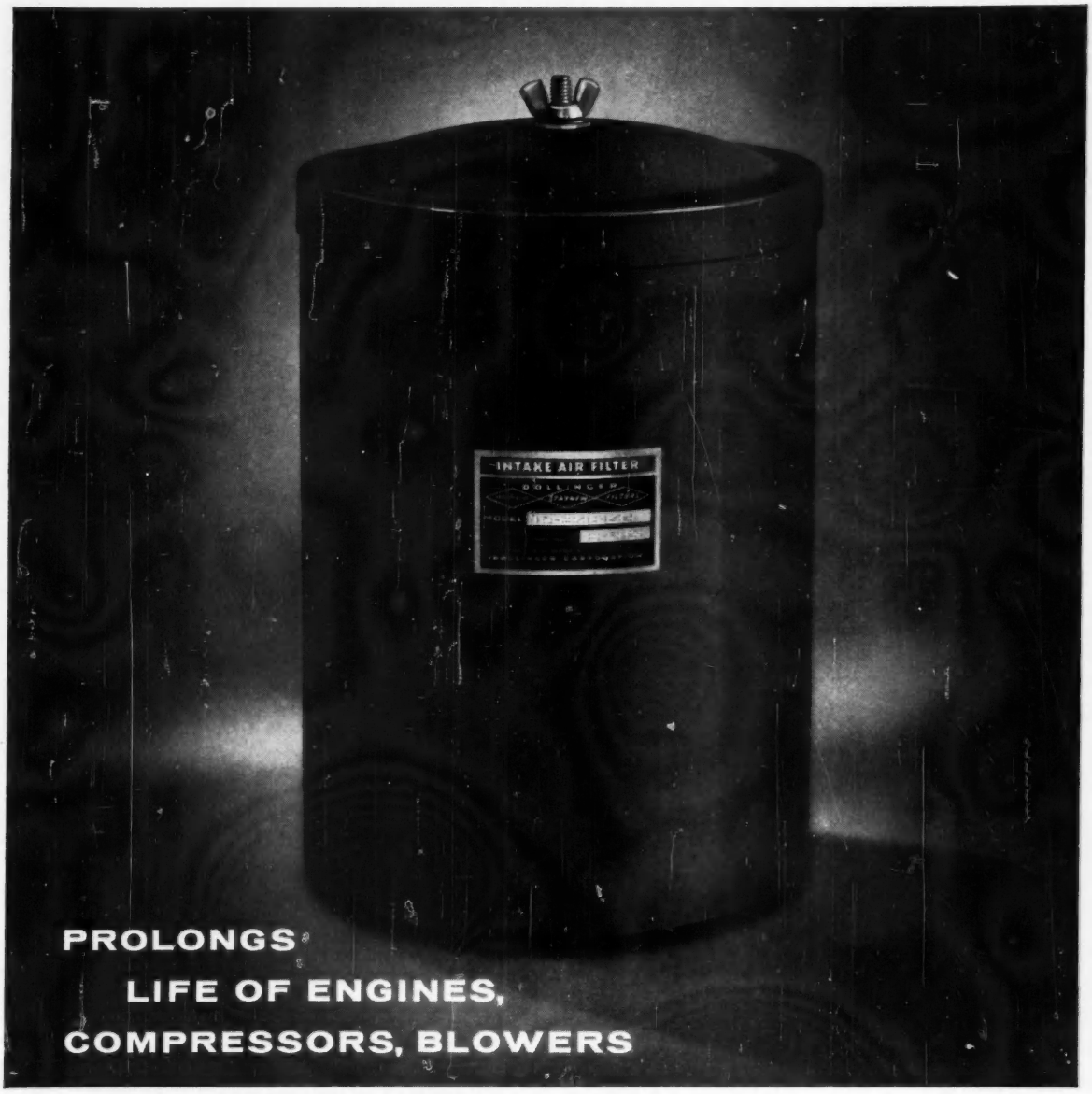


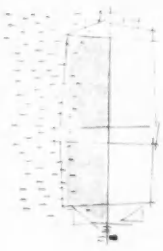

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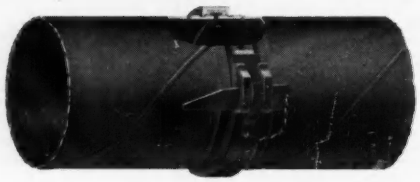
Here's why. This distinctive line has the strength and safety required for rugged jobs. And you can put it together with a hammer. The pipe is light in weight, so it's easy to transport and handle. Connections are simple and fast, too, with the Wedgelock coupling. It is designed to join grooved-end pipe quickly —even with only one side of the pipe in the open. No special tools are required—a hammer is all you need to connect or disconnect the line.



NAYLOR Wedgelock couplings make a positive connection securely anchored in standard weight grooved ends.

**For details on this dependable NAYLOR piping combination, write for a copy of Bulletin No. 59.**

**NAYLOR PIPE** *Company*

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Volume 66 Number 11 November 1961

# Compressed Air MAGAZINE

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BPA Editorial, advertising and publication offices: 942 Memorial Parkway, Phillipsburg, New Jersey. Copyright © 1961 by Compressed Air Magazine Company. All rights reserved. Annual subscription, United States and possessions, $5: foreign, $7; single copies, domestic $0.50, foreign, $0.70. Compressed Air Magazine is indexed in Industrial Arts Index and in Engineering Index. Microfilm volumes (1940 to date) are available from University Microfilms, Inc. Published monthly by Compressed Air Magazine Company: A. W. Loomis, President; L. C. Hopton, Vice President; C. H. Biers, Secretary-Treasurer

on the cover

New pumps were installed at The Ohio Oil Company's Robinson, Ill., refinery this year during its turnaround. This was part of an expansion that increased the refinery output to 55,000 barrels per day. Our cover picture shows a welder working behind some of the piping that makes up the complex network found around any refinery. On page 10 begins the story of this turnaround—a story told, for the most part, in pictures.

6 **Sticky Papers**—R. J. Nemmers

Gummed papers are big business, especially in light of the boom in packaging. How gummed papers and tapes are made is the subject of this article.

10 **Down Time To Prevent Down Time**—S. M. Parkhill

By looking into the future, The Ohio Oil Company is able to completely shut down operations for periodic maintenance. The system has potential for all industry.

13 **The 1961 Turnaround**—Photography by Art Shay

The crude distillation unit is one piece of equipment requiring preventive maintenance. This picture story shows the role of pneumatic tools in doing the job.

18 **Sic Itur Ad Astra**

"This way the road to the stars," was the line from Virgil used by an early aeronaut. Here a review of The Orion Book of Balloons tells about him and others.

26 **Air/Hydraulic Control**

Production of artistic veneers is speeded with a pneumatic and hydraulic positioner.

29 **Hydrostatic Pressure Replaces Shrink Fitting**

Time, money and accuracy are saved by the application of a hydropneumatic pump in assembling heat-transfer elements.

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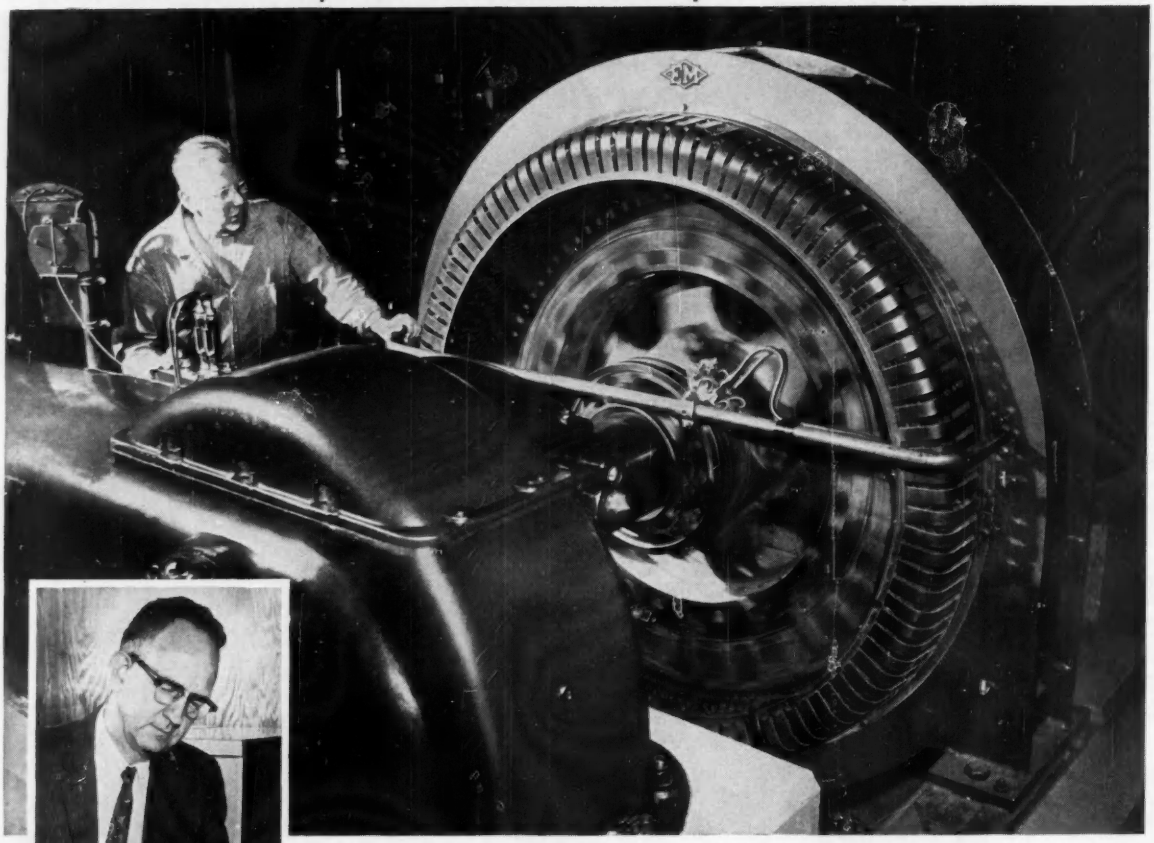
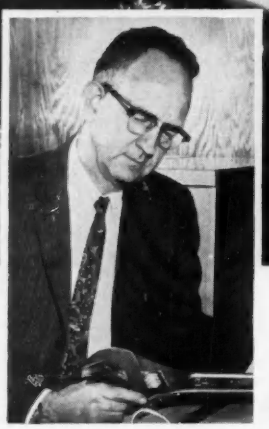
## *E-M Motor starts equivalent of second 50 years of compressor service!*





After running approximately 108,000 hours, this E-M Synchronous Motor is still on compressor duty at Diamond Tool and Horseshoe Co. Contributing to the remarkably long life of the motor was the careful attention of Mr. J. Gordon Mitchell (above), Diamond Tool's electrical maintenance man. The motor is rated 350 hp, 200 rpm, 1.0 PF, 440 volts.

Mr. Hampton Connell, Vice President, Engineering, of Diamond Tool and Horseshoe Co. His company recently celebrated its 50th Anniversary as a manufacturer of hand tools and drop forgings.

# "We just can't seem to wear them out!"

Diamond Tool and Horseshoe Co. of Duluth, Minnesota has an E-M Motor on compressor drive that has been running for the equivalent of *40 hours a week for over 50 years—approximately 108,000 hours!* Yet this same motor is still in service 16 hours a day.

Mr. Hampton Connell of Diamond Tool tells this unsolicited story about his untiring E-M Motor:

"This particular motor was installed about 1942, and was in service 24 hours a day, 7 days a week during the last war. Following the war we operated this unit 24 hours a day, 5 days a week for a considerable period of time. For the past several years we have been running the machine 16 hours a day, 5 days a week.

"We have been using E-M Motors in our factory on our air compressors for a good many years now, and with very satisfactory results."

E-M Motors have earned a reputation for reliability and endurance in many industries. Get more information about them. Call your nearby E-M Sales Engineer and write the factory for free Compressor Number of E-M *Synchronizer*.

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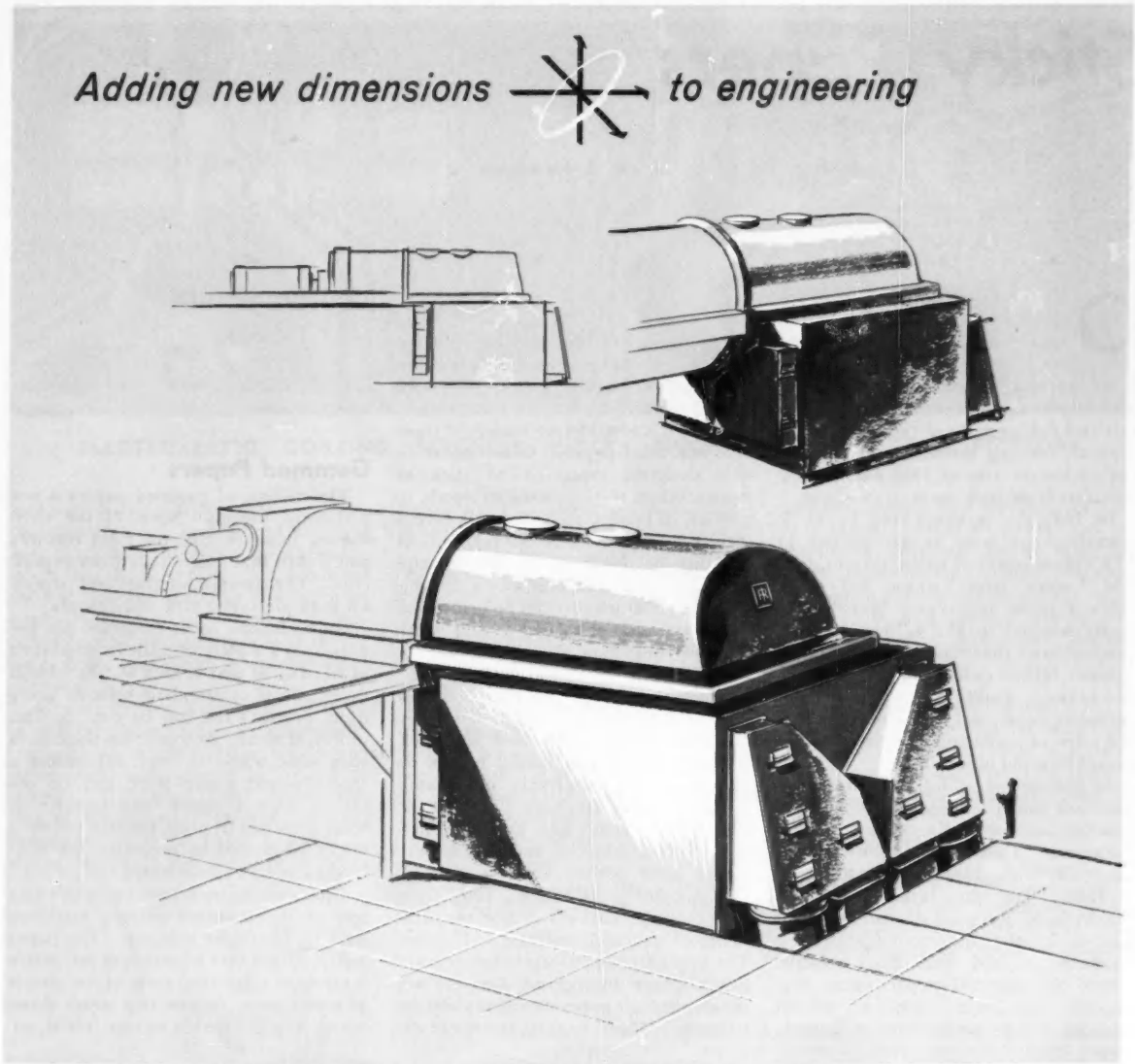
***Specialists in making motors do* EXACTLY WHAT YOU WANT THEM TO**

*Adding new dimensions* — *to engineering*



# Here's the latest concept in steam condenser design*

**(You'll be hearing about this one for a long time to come)**

In no other installation has a surface condenser so completely matched the characteristics of the axial-exhaust turbine it serves. For the first time the condenser tubes have been arranged to parallel the turbine shaft resulting in a steam-flow path that is optimized to provide just the right back-pressure for high-efficiency turbine-condenser operation. At the same time, the condenser is arranged to complement the overall station planning—space requirements are minimized and piping is simplified without sacrificing accessibility.

At Ingersoll-Rand we like to apply new ideas and design concepts to the *overall engineering problem.* That's why I-R condensers continually set the pace for highest performance and adaptability to any *turbine-condenser arrangement.*

**Ingersoll-Rand*Ingersoll-Rand Axial-Inlet Condenser with 145,000 sq. ft. of surface for Southern California Edison Company's Alamitos Station, Units 3 and 4.*

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# Sticky Papers

R. J. Nemmers



"flat-as-a-pancake"

ONE OF THE distinguishing marks of this age is the rapid switch from bulk to individual or small-lot packaging. It manifests itself in the transparent vacuum-formed shields around polished hardware items, in hard, soft and fliptop packs of cigarettes, in individual vending machine packages and the enclosures around 1000 and 1 other products from fresh meat to shoelaces.

In 1939 the products sold by U. S. manufacturers were snugly packed in $1.6 billion worth of boxes, cartons, cans and bottles, paper wraps and sacks. With a pause for World War II, the figure jumped to $5.2 billion in 1947, reached twice that about 1955 and added another billion dollars by 1959 to reach $11 billion. Totals for last year are not complete as yet, but indications are that the value of packaging materials has continued its rapid upward pace.

In putting everything from aspirin to zwieback into packages, the problem of labeling and/or sealing the pack is a major one. To meet the problem a wide range of "sticky back" papers has been evolved. For the layman, perhaps, "sticky back" is a good enough term, but people in the industry define their products a good deal more exactly. There are gummed papers—those that require activation with a solvent (usually water) before they will stick. There are the pressure-sensitive varieties, and also a group known as heat seal papers—those backed with a glue activated by heat.

There is a bewildering variety of these tape and label papers. Glues are available designed especially to stick to metals, others to glass, some to woods, to plastics, to fabrics, etc. There is even a special glue that will accept ink without bleeding or distortion of the message when activated. In that way a message (possibly instructions) can be printed on the reverse side of a label so that it can be read through a glass bottle and its contents.

Papers themselves vary, too. Some are suitable for offset, others for letterpress printing. Some work well for both. There are high gloss coated papers for the ultimate in appearance and quality, as well as the krafts—brown, natural and white—for strength and utility. There are colored stocks, too, and the metallics —gold, silver, copper, etc.

Brown-Bridge Mills, Inc., Troy, Ohio, is one of the nation's largest manufacturers of gummed and heat-seal papers. The firm sells its products to printers and lithographers throughout the country, mostly through paper merchants and distributors. These, in turn, print and die-cut labels and tapes for manufacturers and packagers.

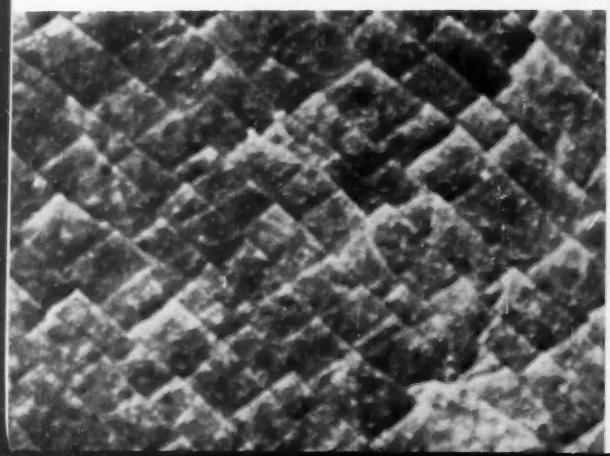
## Gummed Papers

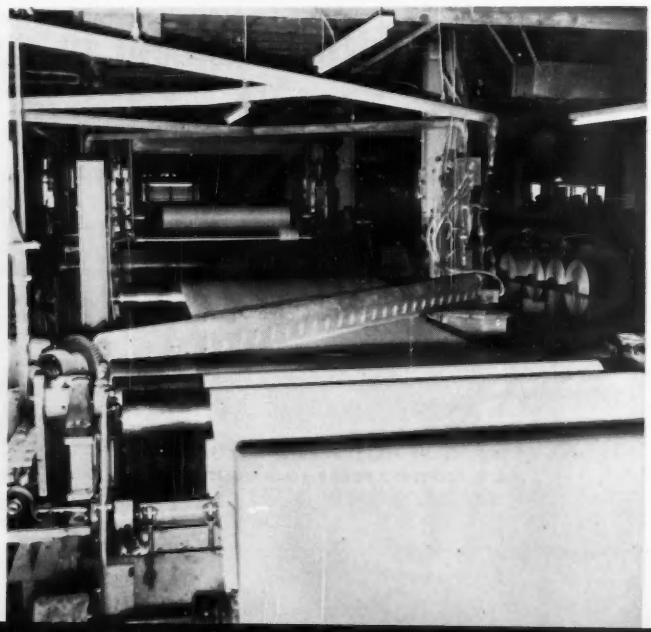
The making of gummed papers is not a difficult process. Some of the techniques, however, call for rigid controls and a skill that comes only from experience. The selection of glues and papers, for example, is complex and difficult.

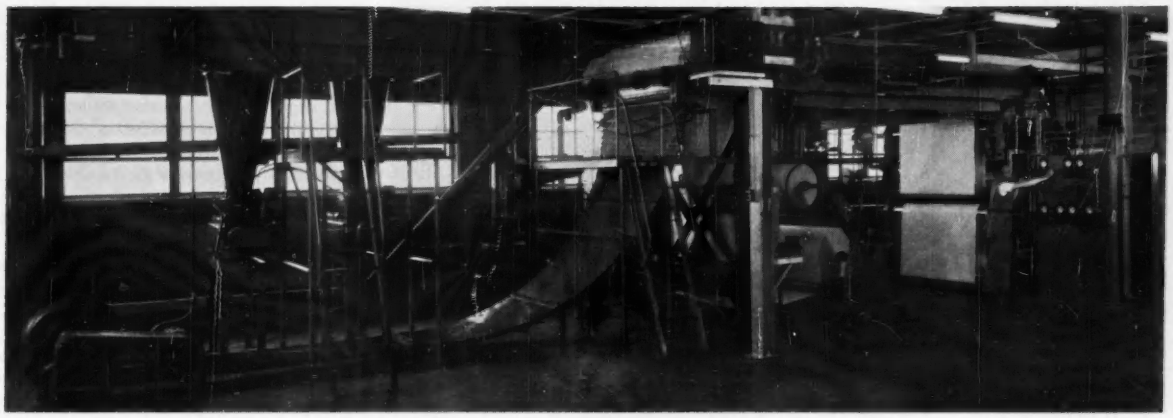
Brown-Bridge Mills purchases its papers from a variety of mills in large rolls of 40-, 44-, 50- and 51-inch widths. From these, sheets or standard rolls of every usual printer's size can be cut. Special orders, if small, are cut from these sizes with some waste; if large, oftentimes a specially-sized paper stock can be obtained from a paper manufacturer at some premium in price, but still less than might be wasted by trimming the next larger standard size to order.

Glue coating machines are much like any of the standard coating machines used by the paper industry. The paper web is passed over a spreading roll where a carefully controlled layer of the glue is put on. Next in line is a steam drum where the glue takes on an initial set,

**BROKEN PAPER** This photomicrograph shows a gummed surface fractured into microscopically small "islands" of glue, thus leaving space between each tiny segment for the glue to expand and contract with humidity changes. Such papers do not curl as do many ordinary brown sealing tapes. The job is done on the machine shown at the right. In a single pass, the web of paper is drawn over a pair of knife edges (glue side up).







**ELECTROSTATIC COATING MACHINE WORKS MUCH LIKE DUST PRECIPITATORS**

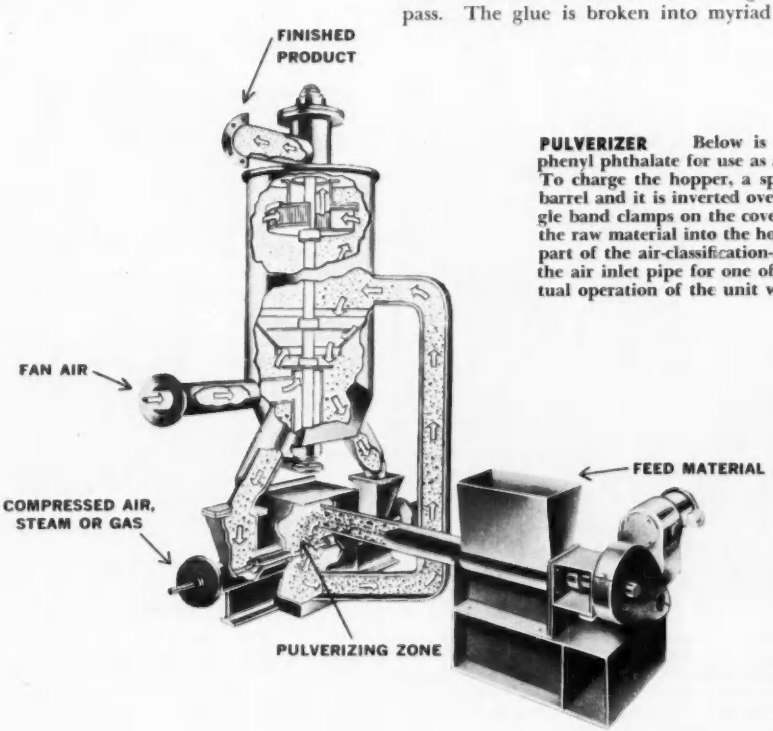
and then comes a drying chamber where moisture content is adjusted to rigid specifications. Although it might be supposed that the drier the better, this is not the case. If carried too far, the paper becomes harsh and stiff, even as do uncoated stocks. What happens if drying isn't carried far enough is too obvious to mention.

After drying, the rewound coated stock is held for about 10 days in a conditioning room where temperature and humidity are held unvarying at 75° F and 45 percent. The same rigid atmospheric control is maintained through finishing operations until the paper is sealed in waxed wrappers for shipment. After seasoning, the paper is mechanically treated to correct the curling familiar to all who have used common brown sealing tapes. If at a given temperature and humidity a gummed paper is flat, then the coated side will expand and curl the paper to a convex cross-section on picking up moisture from the air. If it loses moisture, it becomes concave. The process may be likened to putting in expansion/contraction joints. It can be done by hand by drawing the paper, coated side up, across a sharp table edge with the centerline of the paper at a 45 degree angle to the table edge. Then the paper is turned 90 degrees and the drawing repeated. The process is called breaking and is done on a machine in a single pass. The glue is broken into myriad tiny islands with room between for each to expand. Broken papers can be handled by printers with no more difficulty than ordinary paper, providing that humidity does not get too far out of hand. The Brown-Bridge line is marketed under the trademark "flat-as-a-pancake."

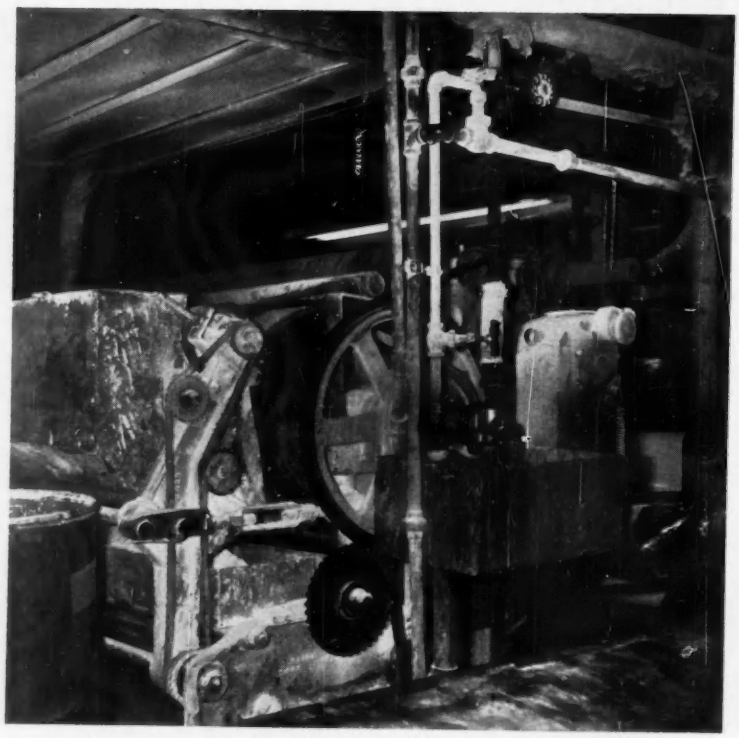
From the breaker, the rolls go to rewind machines for slitting and sizing to requirements, or to sheeters where the web is cut into sheets just as in a paper mill. After final inspection, the paper is then weighed or counted and packed for shipping.

## *Electrostatic Process*

The company also makes a gummed paper by a dry electrostatic process. The product requires no breaking, remains




**PULVERIZER** Below is shown the Majac pulverizer that reduces diphenyl phthalate for use as a drier in the manufacture of heat seal papers. To charge the hopper, a special flanged cover is placed over the opened barrel and it is inverted over the hopper and sealed to it by means of toggle band clamps on the cover. A sliding gate may then be opened to feed the raw material into the hopper. In this view, the manometers at left are part of the air-classification-stream controls. Just below these can be seen the air inlet pipe for one of the jets. The cutaway drawing shows the actual operation of the unit with air and material flows indicated.



**SEPARATION AND USE** The classification air stream from the Majac pulverizer goes overhead to a Pangborn cyclone separator shown in the top view. The reduced product is repackaged in the same barrels in which it was received and tightly capped until used. In the lower picture is shown the spreader box from which the diphenyl phthalate is applied to the heat-seal-coater paper web. The material is loaded into the machine by hand scoop from the barrel in the left foreground.

perfectly flat under extremes of humidity beyond those that can be endured by broken wet-coated types. Developed by Brown-Bridge Mills, in co-operation with Battelle Memorial Institute and Dilts Division, The Black-Clawson Company, the process relies on the same principles applied to electrostatic deposition of dusts.

A water remoistenable glue mixed with a binder is finely ground and dispersed in an air stream. The suspension is directed to a deposition chamber where the particles are electrically charged by a unipolar discharge from a series of wires at a high potential. The charged particles then migrate to a paper web passing over a grounded drum electrode. (The paper itself is preconditioned with water or live steam to adjust its resistivity to aid in this step. If the charge is not properly drained, the finish of the coating can be marred by electrical disturbances.)

After leaving the coater, the web then passes over heated rolls to set the binder into a permanently soft material holding the tiny grains of glue. Or, if solvent activated binders are used, the web is passed through solvent vapor tanks for setting. Thereafter the paper is handled as are broken wet-coated papers.

The glues and binders for the electrostatic process are ground in a pulverizer after being crushed in a hammermill and blended in a ribbon mixer. The output of the pulverizer is a product in the range of 1 to 50 microns, virtually all of it passing a 325-mesh (44-micron) screen.

## *Heat Seal Papers*

Although heat setting seals have been known for centuries (waxes, asphalts and tars have been used almost since the beginning of recorded history), it is only in the post-war era that heat sealing techniques have come into wide use. When they arrived, however, they came with explosive impact and their growth has been as spectacular as the rise in packing itself. Heat seal labels have advantages over gummed ones from a variety of standpoints, but are no panacea for all packaging or labeling problems.

Perhaps their greatest use is in connection with high-speed automatic packaging, wrapping and labeling machines. The speed with which heat seals set up gives them a distinct advantage on such machines. In addition, heat seals often will have a considerably longer shelf life than most gummed papers and, for many nonperishable items, this is of great importance. On the other hand, two of the greatest users of heat seal papers are the food and pharmaceutical industries. They are used both for nonrigid packages and rigid ones such as cans and jars.

There are two general types of heat seal papers. Those that are called *instantaneous* require simultaneous appli-

cation of heat and pressure. The second type are the so-called *delayed* ones that may be heated at one point and applied to the package with pressure at another. (Even so, the delayed type is usually applied with simultaneous heat and pressure.) One case, however, where delayed papers are valuable is for those products that are heat sensitive, again usually foods and pharmaceuticals.

Heat sensitive adhesives are applied in much the same way as gummed ones, that is, by passing a paper web over glue rolls that place an even coating of the hot material on the paper. Simple cooling does not, however, remove all stickiness from the heat seal adhesive as does drying of the gummed ones. Instead, a finely powdered drier—one that will not interfere with later use of the product—must be sprinkled over the coating. Brown-Bridge Mills uses diphenyl phthalate for this purpose. It is an ester of the organic phthalic acid, insoluble in water and having a melting point in the range of 140° F.

The small size to which the diphenyl phthalate must be ground presented some problems. The process calls for an average material size of about 1 to 20 microns. Materials with low melting points are notoriously difficult to pulverize because even a momentary rise in temperature to the softening point will cause it to adhere to the mill surfaces and foul process equipment. In some respects, it's like trying to grind marshmallows. In conventional pulverizers, considerable frictional heat is generated and, further, there is no practicable way to remove that heat quickly and efficiently.

To solve this problem, Brown-Bridge engineers selected and installed a compressed-air-powered jet pulverizer. This Majac, Inc., unit pulverizes the diphenyl phthalate by entraining it in opposing streams of high velocity compressed air. The material reduces itself by the mid-air impaction or impingement of one particle on another.

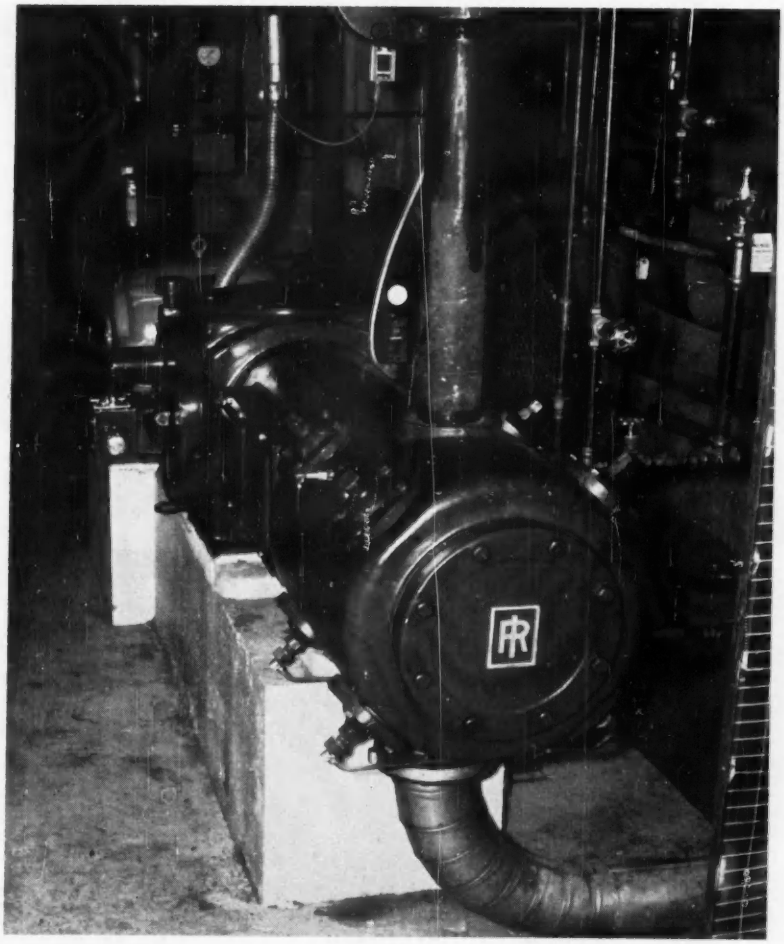
The machine also depends on an air stream for classification of the ground material. A fan-induced stream is introduced into the unit at a pressure and velocity sufficient only to carry upward and out of the pulverizer those particles smaller than a predetermined maximum size. The ones larger and therefore heavier than the proper size fall to the base of the unit where they are refed to the air entrainment chambers for another go 'round.

The Majac unit has a design capacity of 250 pounds per hour to a finished average particle size no greater than 2.05 microns as determined by the Fisher Sub-Sieve Sizer. Feed to the machine for this rating is to show an analysis of 13.7 percent plus 20 mesh and 28.4 percent minus 325 mesh, the average size being 13.7 microns. The output is predicated upon an air supply of 150 scfm to the nozzles at 100 psig and 70° F. The intimate contact of the dispersed diphenyl phthalate with its carrier air stream, and the turbulence and high velocity flows combine to reduce frictional heat to a minimum and dissipate any heat increase at a rapid rate.

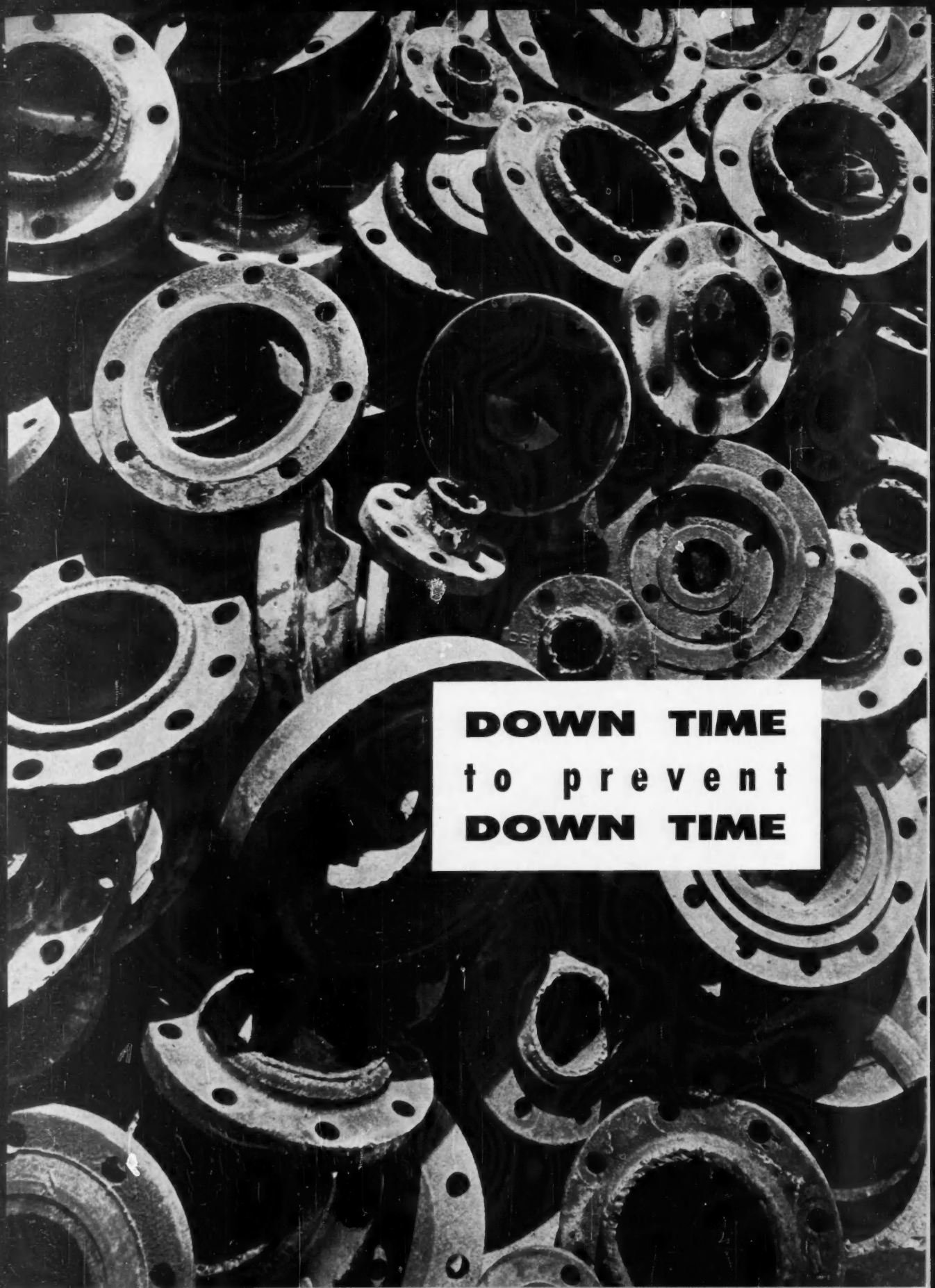
The Majac pulverizer is supplied with compressed air by a 10x9-inch ESH-1 straight-line double-acting compressor rated at 362 cfm (piston displacement) at a nominal discharge pressure of 125 psig. The unit discharges to a pipeline-type aftercooler.

The classified particles from the Majac unit are discharged overhead to a Pangborn cyclone separator and delivered to barrels for storage until needed. The cleaned air is discharged to atmosphere.

On the coating machine, the small quantities of diphenyl phthalate required are drawn from the barrel with a hand scoop and put into the spreading box. As the fine powder is deposited on the fast-moving web it aids in cooling the adhesive and removes the last traces of stickiness. The paper web is then rewound and subsequent treatments follow closely the pattern of the gummed varieties except that no conditioning period is required. The heat seal papers require no more protection from humidity than do ordinary paper stocks (all of which will curl or warp if conditions are too extreme). They do have to be protected from heat. There are cases on record where printers, who customarily use an open gas flame on some presses to help dry inks, forgot what they were doing and wound up with a solid, blocked stack of printed labels. Beyond such obvious restrictions, however, there are none that interfere seriously with any of the various methods of printing and die-cutting.



**AIR PLANT** Shown here is the Ingersoll-Rand 10x9-inch ESH-1 machine supplying air to the jet pulverizer. The unit has a rated capacity of 362 cfm at nominal 125-psig pressure. The pulverizer requires 100-psig air, thus the compressor is set to cut in at 102 psig, and cut out at 110 psig pressure. It discharges overhead to a PL (pipeline) aftercooler, and then into the receiver visible in the background.


DOWN TIME
to prevent
DOWN TIME

# *The Ohio Oil Company's Refinery At Robinson, Ill., Uses Planned Shutdowns For Maintenance, Thereby Preventing Costly Unplanned Work Stoppages.*

**S. M. Parkhill**

MAINTENANCE has considerably different connotations depending on the equipment being considered. Plant engineers and maintenance supervisors are familar with the routines that must be followed for small pneumatic drills or large air compressors. By the nature of a refinery, however, total maintenance seems an impossible task. Flow must be constant if firm product commitments to customers are to be achieved. Generally, down time on any of the large crude distillation units, catalytic crackers, cat reformers, alkylation units, cokers or the like would, at worst, stop production, or, at the least, sharply curtail output. Maintenance to prevent such unexpected down time is a necessity.

Like all refineries, The Ohio Oil Company's plant at Robinson, Ill., contracts to produce a certain quantity of product each year. Prolonged unscheduled down time means the company must purchase its petroleum products from outside sources for resale to its customers —in this case, essentially 3000 Marathon dealers. Consequently it has devised a maintenance method that can be best summed up with the words: *a look into the future*. The procedure might well be adapted not only to other process industries but to those manufacturers whose profits depend on a steady input-through-output flow of material as well.

The refinery plans ahead, and in this planning is able to completely shut down all production for a period of about 4 weeks. During this time, all component parts are dismantled, inspected, repaired if necessary and re-inspected, and then reassembled so the refinery can be put back on stream in the least possible time. Maintenance and inspection are based on future runs: Will the equipment withstand the type and quantity of load predicted for the next interval?

The system that is working so efficiently at Robinson was not the result of overnight planning. It has taken years of thought, analysis of records, careful scheduling of men and their tools, the wise application of pneumatic equipment, and the co-ordination and co-operation of all personnel to complete the job swiftly. The results prove this effort worthwhile. As a result of planned down time, the refinery derives such benefits as economical operation, less overtime, an excellent safety record, better customer relations, consistent top-quality products, and most important, a sharp decrease in budget-wrecking unscheduled shutdowns.

The equipment at the refinery can be divided into four classes: mechanical, electrical, instrumentation and pressure. Starting years ago, records have been kept indicating every type of repair that was done. In some cases, so-called "hot spots" showed up, pointing out the need for a change in equipment to improve performance quality and decrease the amount of money being spent for repairs. This program was carried on around-the-clock.

With expansion, such a demand-maintenance program was costly and time-consuming. Fortunately records had been kept so they could be analyzed. Specific conclusions were drawn for a planned maintenance program.

First it was decided what was to be maintained. All equipment that fell into this category was given a number. Then based on the past records and "horse sense," the frequency of maintenance was determined for each piece. Today, work orders are preplanned for 1 year from this frequency curve. With mechanical equipment, for example, there is a major quarterly check by craftsmen and regular inspectors. Of course routine inspection takes place during all on-stream hours and most major equipment has stand-by units in the event of an emergency. Lubrication is also done on a predetermined schedule. Daily records are maintained and the frequency-of-maintenance curve is constantly changed.

This system works smoothly with mechanical, electrical and even instrumentation equipment, but because of the nature of the pressure equipment, exactly the same routine cannot be followed. Since repairs on vessels, piping, valves and the like can only be made when the equipment is not in operation, complete shutdowns were indicated. At first it was considered economically feasible to stop operations for a 4-week period every 6 months. With the advent of improved equipment, better metals, changes in product, and variations in loads, the interval between complete turnarounds for maintenance of pressure equipment has been lengthened. The refinery was able to be on stream for 12 months at a time, then 18 months. It has completed its 1961 turnaround; the next is not scheduled for 2 years—a new time record.

Generally, each turnaround requires 4 weeks. The most recent one, from which the photographs on the following pages were taken, lasted 6 weeks because certain facilities were expanded.

Since all down time is critical, even though it is planned, it is necessary to work according to a strict time schedule and with a specific routine. Some years ago a refinery employee started keeping a record of all the tools that were necessary to repair one piece of equipment. When that unit needed repair, he could tell exactly how many men were required, what materials they had to take to the problem site, and how long it would take them to complete the job. Working in his spare time and off-duty hours, he completed such a list for every piece of pressure equipment in the plant. These lists have been incorporated in Turnaround Books. Every required item is listed, from rope to the type of pneumatic tools, from special clothing to the number of, say, 8-ounce cans of cup

**The Ohio Oil Company was born in 1887 when fourteen producers joined forces. The company prospered and expanded in all directions. In 1924 it purchased a small 750-barrel-per-day refinery at Robinson, beginning the company's entry into the refining and marketing phases of the industry. Expansion continued: far-reaching exploration and development of fields, improved marketing facilities, and extended pipeline systems. In 1949, the refinery at Robinson underwent its own major expansion and modernization program that resulted in virtually a new plant. Five years later, it claimed to be the most advanced refinery in the region. Capacity was 40,000 barrels per day. After the expansion during the 1961 turnaround, the refinery assumed the position of largest producer of Ohio Oil's three plants. Measured traditionally at the crude distillation unit, its capacity is 55,000 barrels per day. One at Detroit has a 45,000-barrel-per-day capacity; the refinery at Muskegon, Mich., 15,000-barrel-per-day output. All the products from Robinson are marketed under the trade name Marathon. (Ohio Oil's other one is Speedway 79.)**

grease, from scaffolding to putty knives. The hackneyed joke about the plumber who always has to go back for more tools would never apply to the men at the Robinson refinery.

Based on these elaborate Turnaround Books, which incidentally are invaluable during emergency repairs too, an estimate is made of the man-hours required and the material costs. (Replacement stocks are kept on the usual maximum-minimum basis.) Then the product inventory is checked, and production increased appropriately to carry the refinery through its commitments during the planned down time. Tools are checked in the tool room to make sure they are in good working order, and there must be enough for the number of men who will be working the turnaround. (During the recent one, some 500 were employed. Of these, about 150 were from an outside contractor.) Any new tools that are needed are purchased several months before the actual turnaround begins. Thirty days before, all routine maintenance jobs stop.

Then the refinery is shut down and an operation known as blanking is carried out. From 400 to 500 blinding blanks are installed, covering inlet and outlet piping ports to prevent anyone from accidentally turning on a product line and flooding a man working in a vessel. Each blank is triple checked to be sure it is in position.

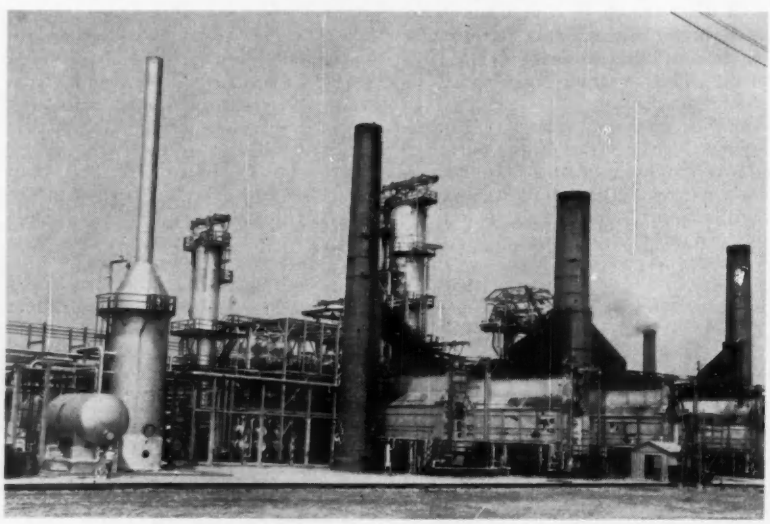
For turnaround tasks, every employee is assigned to a working team consisting of from three to eight men. Each knows his specific job beforehand, for all work is laid out on master sheets from which individual job tickets are derived. Shown on these sheets are all projects, the crews assigned them, the pushers (expediters), dates for starting, inspection and completion and the shifts. The crews are numbered, and each crew strikes out to its assigned equipment. The man-hours needed to tear down, repair if necessary, inspect, and reassemble each piece are known and taken into account. If the job can be completed before the end of the turnaround, the crew is reassigned to another task. Emphasis throughout is to get the material back on the line in a hurry because of the dwindling product inventory, but equal emphasis is placed on producing quality work that will withstand the rigors of the next planned run.

Throughout the 4-week period there is a full-scale metal inspection department that does nothing but check metal. Metal failure from erosion, corrosion and chemical reaction is one of the most serious causes of unplanned down time. Full advantage is taken of new alloys, new fabricating processes, and the like. Inspectors in this group also check for the future: Will the metal last through the planned forthcoming run?

Each crew chief reports back to turnaround headquarters, a special building constructed in the refinery area from which commands are issued. Inspections are made and the completed work is ticked off on the master sheets. When all is done, blinding blanks are removed and the refinery is ready to go back on stream. A stand-by crew is ready in case of emergency, although most of its work is with instrumentation rather than pressure equipment.

Pneumatic tools are returned to the tool room where they are broken down for their own maintenance. Those that need special repairs are sent to the machine shop. When all the equipment is back in shape, it is returned to the shelf for use during regular maintenance operations. Some of it will not be used until the next complete turnaround.

It is difficult to get into a refinery during a turnaround because of the well-ordered chaos. We were fortunate in having photographer Art Shay at Robinson to take the photographs that appear in this article. They show operations around the various components of the crude distillation unit—probably the most important single piece of pressure equipment, for all the crude inflow must first pass through this unit. It separates the products that naturally appear in the "sweet" Illinois crude: gasoline, which is treated and blended and turned out as a finished Marathon product; kerosene, which is treated mildly before being considered a finished product; diesel fuel; gas oil, which becomes cat cracker stock; and residual crude which is sent to the coking unit. About 95 percent of the input is turned out as product, quite unlike the early days of petroleum refining.



**CRUDE UNIT** **The crude distillation unit shows clearly the components that underwent the turnaround described in the following photo story. At right are the three preheater furnaces. To their left, and partially obstructed by piping are the heat exchangers. The fractionating tower rises behind them and to its right stands the vacuum column.**

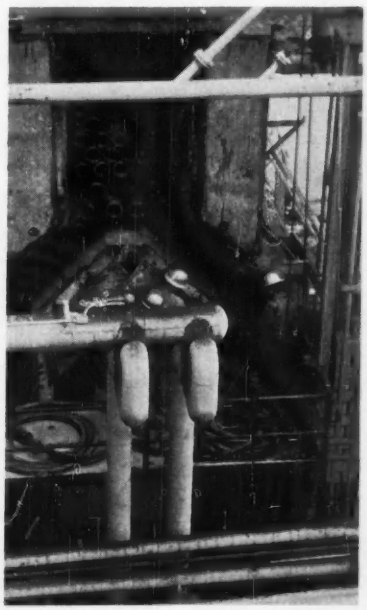
# The 1961 Turnaround

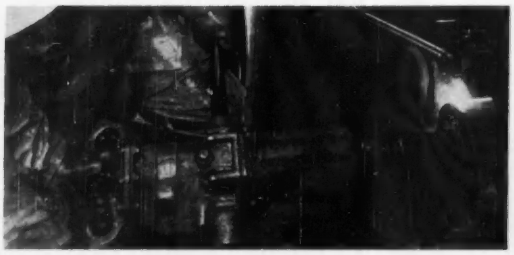
**Photography by Art Shay**

PNEUMATIC TOOLS play a vital role in achieving the quickest possible turnaround consistent with quality work. They operate accurately and with dispatch. Their safety in hazardous atmospheres and their ability to work in the most adverse dirt and weather conditions cannot be overly stressed. The pictures that follow show some of them at work on the all-important crude distillation unit at The Ohio Oil Company's refinery southeast of Robinson, Ill.

COMMAND center for the 4-week turnaround is this building located near the crude distillation unit. Operations are seemingly hectic and confused, but have the order and organization of a vast military campaign. Work progress is checked on master sheets, crews dispatched, reports from inspectors received and individual work orders issued. Check marks start to fill the ruled squares, slowly at first and then with an avalanche until equipment is ready to go on stream.

## PRIMARY HEATERS

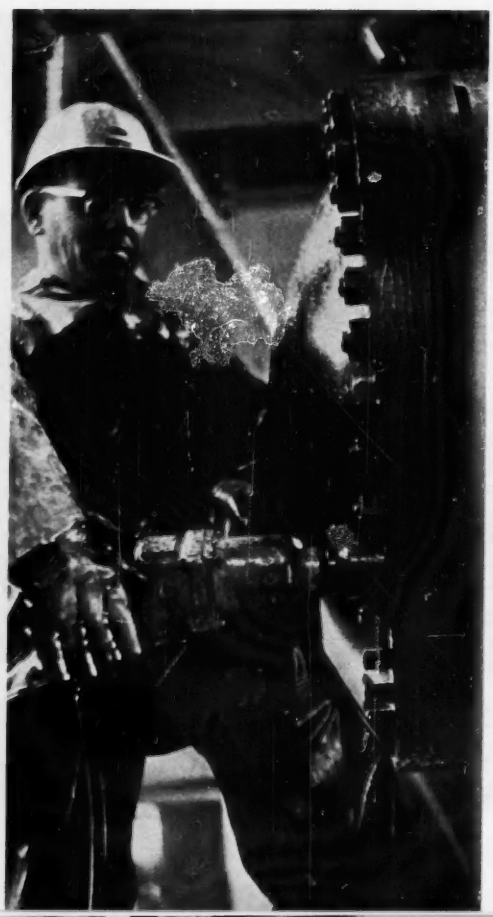


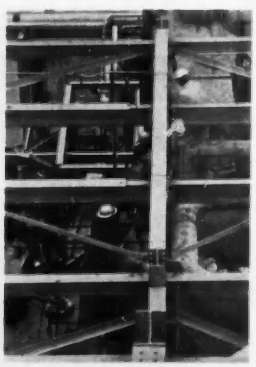


ONE of the three primary heaters in the crude unit is shown (**left**). Note the heat exchanger pipes that surround it. Each must be cleaned: an air motor pulls itself and a wire cleaner through to do the job. Before tubes can be cleaned, plugs must be removed. This operation is illustrated (**above**). The 3-man team uses a blow torch and an Ingersoll-Rand Size 577 Impactool. In normal turnarounds, the torch is not necessary for the plugs are removed before the primary heater is cooled. This time the plugs had become too firmly set and needed the additional heating. An elevator is required at this location. It is powered by an I-R 33SJ drill (**right**) with a special chain sprocket adapter to run a chain-type hoist that lifts the elevator.

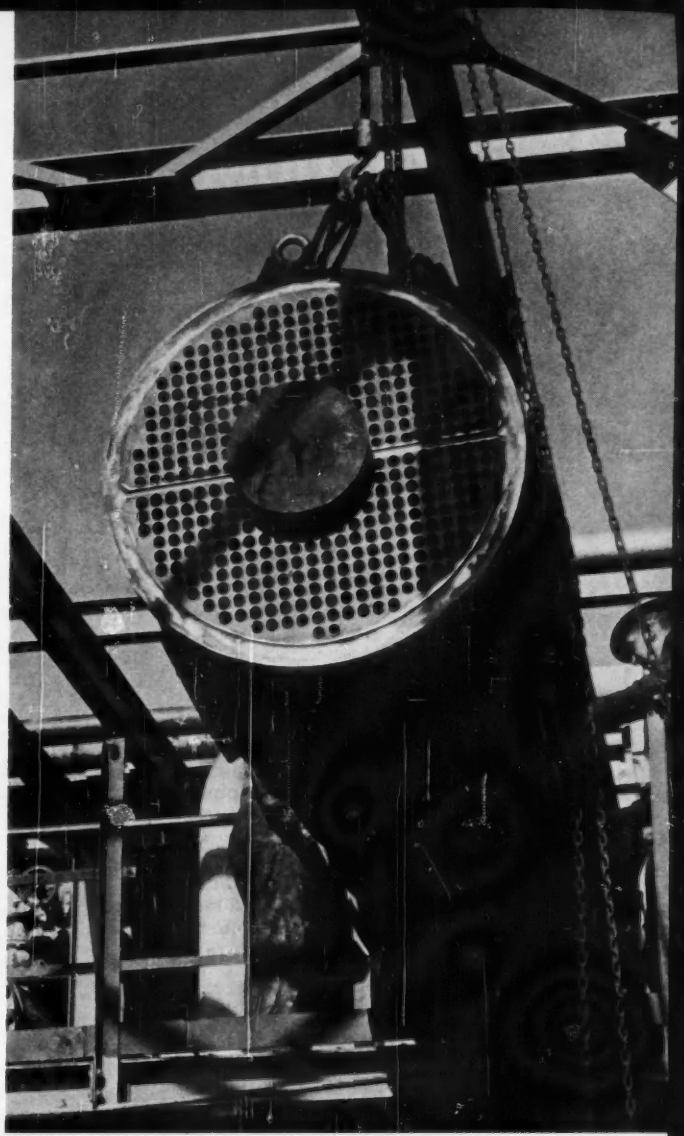
# HEAT EXCHANGER

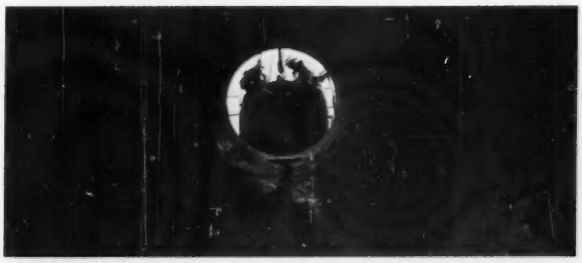
HEAT EXCHANGER and tube bundles are important components of the crude unit. An over-all view of one section is pictured (**below, right**). A crew using an Ingersoll-Rand Size 834 Impactool removes the fasteners on the head of one of the exchangers (**below, left**). The refinery has 210 of these shell and tube floating head heat exchangers. About 70 percent were turned around. The head is further dismantled (**bottom, right**) with a Size 538 Impactool. Both tools have the power necessary to run off the nuts quickly and efficiently. Stalling will not harm the tools, and the dust-laden air has no effect on efficiency.



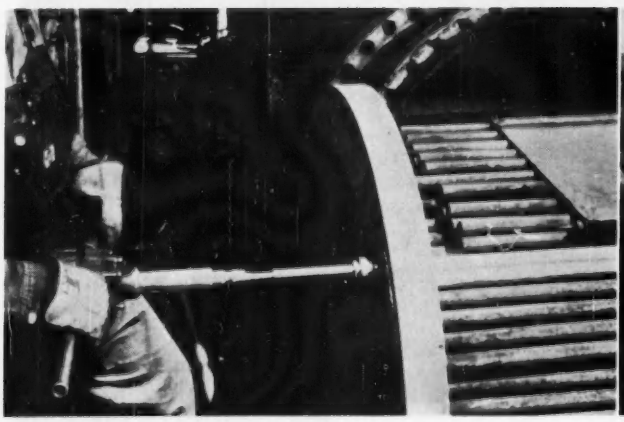


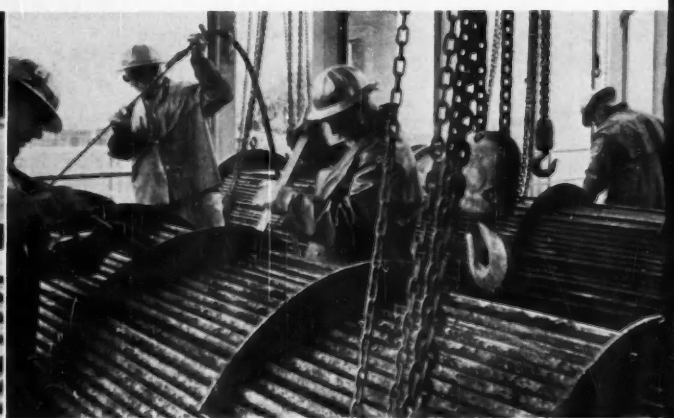
ONCE the heads are removed, they must be cleaned thoroughly if they are to pass inspection. Ingersoll-Rand 4G45 grinders with wire-brush attachments clean flanges (**below**).



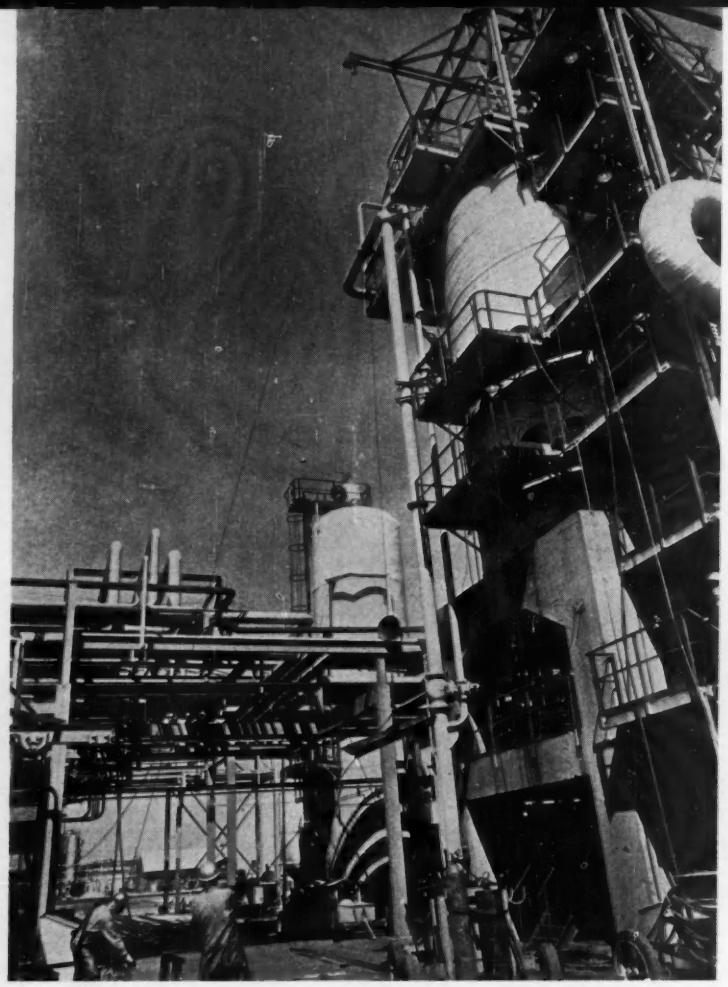


MEANWHILE tubes have been pulled (**left and above**) and moved away so bundles can be hand cleaned. Scale is chipped off and blown away with compressed air (**below**). When necessary, tubes are replaced, an I-R 22M pneumatic drill equipped with a tube-rolling attachment helping in the job (**below, left**).



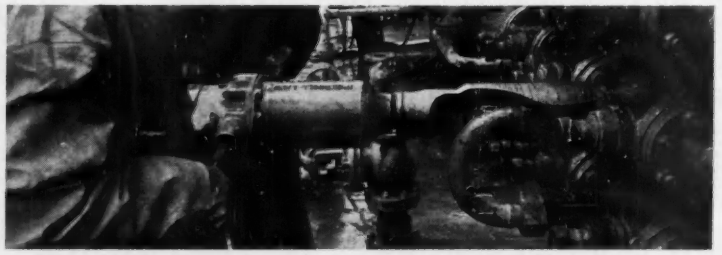


# VACUUM TOWER

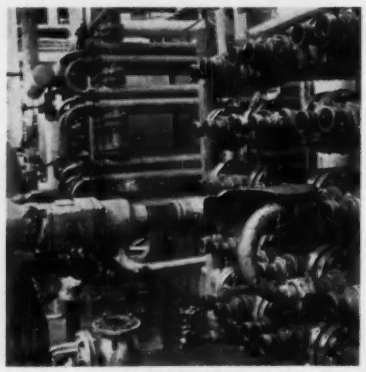


RAISING and lowering trays used in the vacuum tower is done with a pneumatic hoist (**right**). Close-up views around this area reveal some revamping being done to increase refinery output, a 4G45 grinder dressing a hole for added piping, for example (**center**). Three of the indispensible pneumatic tools used around the vacuum tower inlets are shown (**left**): a 181L scaler in background; a 2A chipper, right; and a 2S60 grinder, left. All are standard Ingersoll-Rand units, for standardization in tools is demanded if every turnaround is to be accomplished as quickly as possible.

# COOLERS



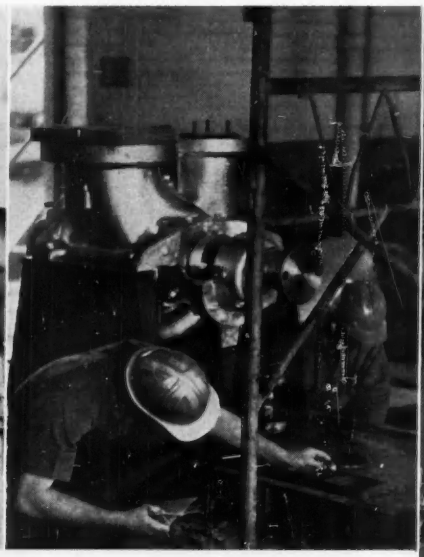
THE crude unit also depends on the efficiency of its G-Fin coolers, so named because of their construction. They are used in preheat service. At Robinson, in countercurrent flow, they prove versatile although they operate under very severe thermodynamic conditions. Semicircular connecting pipes must be removed (**right and center**). Because of their nature, a standard air wrench cannot be applied. Therefore Ohio Oil Company devised a special socket for Ingersoll-Rand's Size 844 Impactool to remove these header pipes. Another phase of this work is cleaning the Griscom fins themselves (**bottom, right**). This is done similarly to the tube bundles from the heat exchangers.



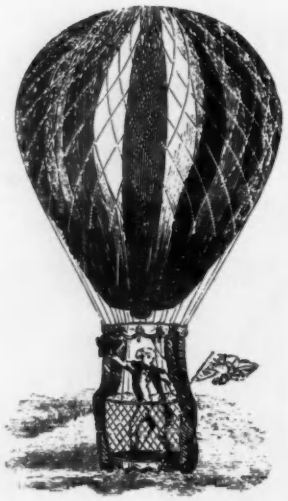
# MACHINE SHOP

SOME components must be returned to the machine shop for work. Three air tools used are shown: (**left**) a 181L scaler chips weld; (**center**) a 1S120 grinder performs a wirebrushing job; and (**right**) an Ingersoll-Rand 22M air drill with special attachment that expands from centrifugal force hones a cylinder.

# EXPANSION



DURING the recent turnaround, Ohio Oil expanded its output at Robinson. Part of the new equipment installed during the shutdown included four pumps: two 6CJVL pumps (illustrated) and two 8JVL units. These will eliminate one of the former "hot spots." First the old foundation has to be removed (**left**) with a 9A riveter with a special chisel retainer. The new foundation was laid (**center**), and pumps installed (**right**). Certain modifications in piping were required, but were expediently handled with an 808 Impactool, shown in the top of the photo at right.



THE ORION BOOK OF BALLOONS. By Charles Dollfus. Translated by Carter Mason. 108 pp. New York: The Orion Press. $6.95.

# SIC ITUR AD ASTRA

"WHEN a body is completely immersed in a fluid at rest or in two stationary fluids one of which lies above the other, the body is buoyed up by a vertical force equal in magnitude to the weight of fluid displaced." So said Archimedes, and so begins the table of contents of *The Orion Book of Balloons.* It goes on to say that aerostation is a perfect application of this principle.

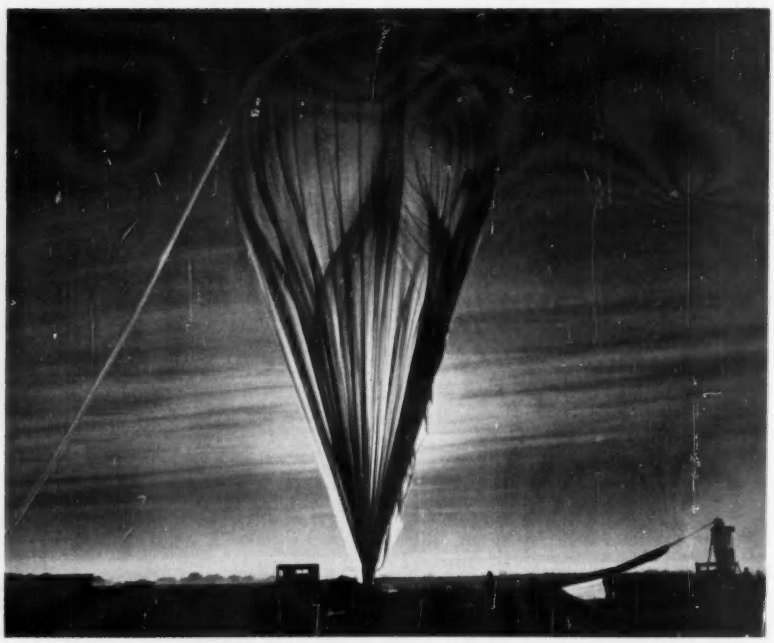
Aerostation, according to author-aeronaut Charles Dollfus, is divided into four major categories: free balloons with neither propelling nor steering mechanisms; dirigible balloons with power; captive balloons; and unmanned balloons. Dollfus has used this division as a kind of mold for the little volume, but the reader is in for some pleasant variations as the subject matter spills over the matrix.

After a brief introduction describing the sport of ballooning, its perils and pleasures, its art and science, Dollfus proceeds to discuss in technical detail the construction and history of the four categories of aerostation. Never is the reading dull. Then follow two chapters on the history of balloons and navigation, and the book ends with a section entitled "Balloons and Science." This last chapter carries the reader from the eighteenth century's amateur scientist-aeronauts Hermite and Besancon through today's astronomer-aeronauts responsible for such achievements as *Stratoscope I, Man High II* and *Echo I.*

Once in a while Dollfus presents his personal points of view: the cause for the *Hindenburg's* burning May 6, 1937; the potential of air travel by dirigibles today; his feelings while watching his son's chain of 105 balloons, grouped in threes, ascend—"(I) can remember none more beautiful, no sight more serene than the sight of this string of balloons, this rosary one-third of a mile long, soaring gently into the stratosphere." Such personal remarks are not objectionable for Charles Dollfus is an authority. He modestly describes himself as being among the "few fanatic amateurs" who in 1919 "were able to revive the sport."

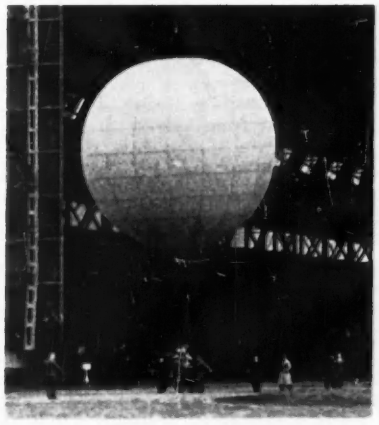
Dollfus has devoted his life to aviation, was the first Frenchman to fly across the Atlantic, and is considered the outstanding balloonist of France. Author of many books, he is also one of the founders of the Museum of the Air. He is curator of the museum of the Aero Club of France, and co-author of the monumental *L'Histoire de l'Aeronautique* with Henri Bouche. It is little wonder that his astronomer son, Audouin Dollfus, is an aeronaut too, and that he has been assisted by his father in many flights. He was the first to successfully use a telescope in a balloon (1954). Dollfus, the father, is an Honorary Life Member of the Wingfoot Lighter-Than-Air Society of Akron, Ohio.

Aerostation was born in France. There the greatest enthusiasm remained for many years. The Montgolfier hot-air balloon of 1783 climaxed centuries of visions of poets and philosophers and planning by men of science, including some of the most gifted—Roger Bacon, Leonardo da Vinci and Emanuel Swedenborg. Like all points of time, 1783 was not only an "end," it was a "beginning" as well. Balloons continue to attract. Bands of aeronauts now enjoy the art and science of aerostation throughout the world. "The amateur



**PRELAUNCH** This typical scene at dawn shows the General Mills balloon nearly inflated. Helium is being admitted through the long tube.

**AUTHOR** This candid shot of the aeronaut was taken aboard the Hindenburg in June 1936. He made the first post-war ascent in England in 1948, left, in a 12,000-cubic-foot free balloon, below. All three pictures are from the archives of the Wingfoot Lighter-Than-Air Society.



pilots and passengers who still make ascents in free balloons are fewer in number today, but they are still full of enthusiasm," says the author. "These amateurs are simple contemplative types, happy to isolate themselves from the world." Especially noteworthy revivals of scientific ballooning are taking place in Switzerland and Belgium, and more recently in the United States and France.

Since the first linen-and-paper balloons of the puckish Montgolfier brothers—Joseph and Etienne—witnesses to launchings are awed:

*Silent, with upturned eyes, unbreathing crowds*
*Pursue the floating wonder to the clouds,*
*And, flushed with transport or benumbered wih fear,*
*Watch, as it rises, the diminished sphere.*

Unfortunately this verse by Erasmus Darwin (1787) does not indicate the apprehension of the scientists, trackers, weather observers and balloon manufacturers behind every launch. Has each of the thousands of details been carefully checked? Will the trip be successful? Will the hoped-for data be gathered? *The Orion Book of Balloons* ends with the detail-checking scientists of the 1960's.

Balloons are curious contraptions—a bundle of contradictions. Unlike 99 percent of today's engineering mechanisms which succeed in becoming increasingly complicated, the design evolution of the balloon has become more and more simple. The free balloon is without engine or steering devices, for example. And it has no rigid framework. It must have great strength and power from the least weight.

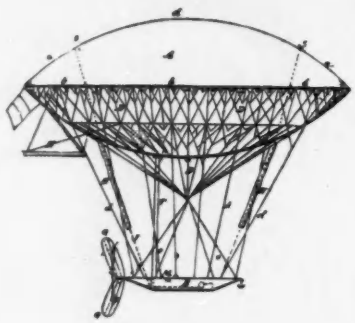
Naturally the material used is of prime importance. In 1936, a rubberized fabric balloon (*Explorer II*) carried two U. S. Army officers aloft in a spherical aluminum chamber. Even with some 250,000 cubic feet of gas, weight prevented ascent higher than 72,395 feet. This was the last major probe into these reaches for some 20 years. A new fabric had to be found.

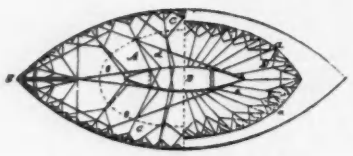
In 1947, University of Minnesota faculty member Dr. Jean Piccard—twin brother of the Swiss scholar Auguste Piccard who is credited with penetrating the stratosphere in 1931, an historical first, and who Dollfus describes as being "from every point of view an unusual personality"—Dr. Piccard began experimenting with cellophane. This was replaced with polyethylene, 1/1000-inch thick and far less delicate. Finally Du Pont's Mylar was tried. Success. Mylar is about a fourth as thick as polyethylene, but a third as strong as machine steel. It is capable of withstanding the extremes of temperature encountered in every ascent. Mylar is also inexpensive, easy to work and expendable.

Even with Mylar and its combinations with other materials, balloons are fragile. Accidental tears are always a threat during complex dawn launchings. The ascent itself is full of danger, contrary to the shimmering peaceful grace of a rising balloon. A sudden downgust immediately after launch could hurl the payload into the ground. Later, passing through the turbulent tropopause where winds are likely to be brisk, the balloon can be sheared from its gondola. At altitude, in the blue-blackness where temperatures drop far below zero, balloons become as brittle as a light bulb. A sudden jolt could cause the orb to shatter.

Even with these disadvantages, balloons have many positive features that make them excellent observation platforms in high-altitude and outer-space exploration. These were recognized very early in the balloon's evolution. Using them for scientific observations has a history that dates from the year after the balloon was invented by the Montgolfiers. In 1784, Dr. John Jeffries, an American physician practicing in England, made an ascent from London carrying barometers, thermometers and hygrometers. He collected samples of air at various heights for later experiments. The following year he accompanied Jean-Pierre Blanchard in a balloon that made the first cross-Channel flight.

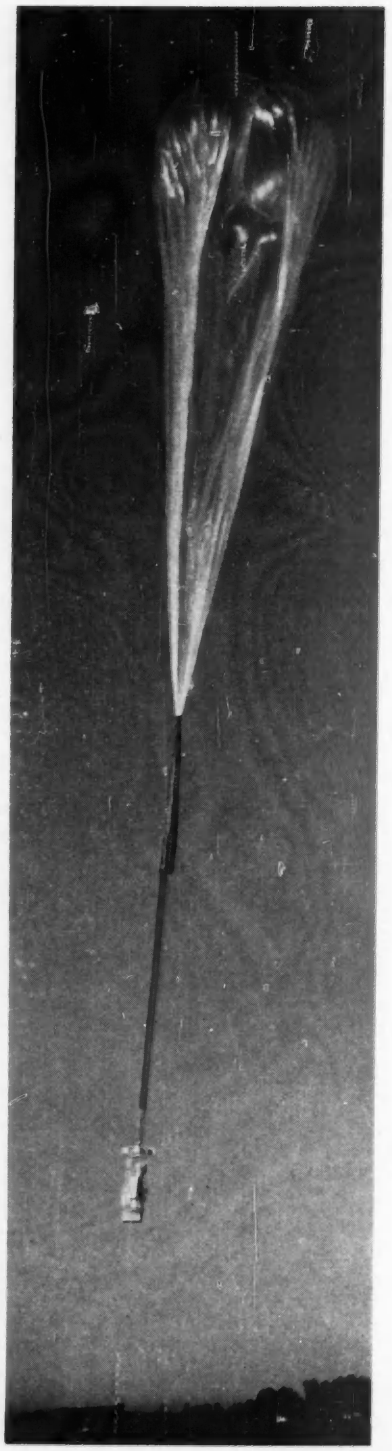
Blanchard was one of the most famous eighteenth-century aeronauts, and is credited with the first ascent in America. Dollfus speaks of him in glowing terms, even though he is often severely criticized by other authors. "I feel it my duty to mention my wholehearted admiration for Blanchard," says Dollfus. "With unequalled courage, *sang-froid*, and skill, he introduced balloon ascents to the Netherlands, to Belgium, to Germany, Poland, Czechoslovakia, Switzer-





**LOCOMOTION** Dupuy de Lome's great balloon was not only unusual because of its shape, but because it could move in any direction by means of a propeller. The power was furnished by men rotating a screw at 25 rpm, causing the aerostat to travel at 52.5 feet per second. Author Dollfus remarks, ". . . eight men had to turn it with manual cranks. An 'alcohol motor,' he (de Lome) quipped as he treated his crew to an encouraging round of rum!" The year was 1872. The experiment was soon followed by a German dirigible equipped with a 4-cylinder internal combustion engine that used the balloon's gas for fuel.

**FREE BALLOON** The General Mill's photograph at right shows a 1959 launch from Lake Echo Airport, 10 miles east of St. Paul, Minn.



land, and the United States. In spite of incredible difficulties involved in the production of hydrogen at that time in unindustrialized countries, he completed almost all of the ascents successfully. . . . Although he earned large sums of money, he also showed amazing generosity throughout his long career. Finally, we owe him a great deal for making important improvements in rigging tackle and for introducing propellers to air travel."

As an advertising slogan, Blanchard used the line from Virgil: *Sic itur ad astra*—This way the road to the stars. Admission to his flights was expensive, but viewers were rewarded with a rollicking show.

On his trans-Channel flight, Blanchard carried a letter to Benjamin Franklin—the first air mail. Franklin, who was in France during this period, was most interested in ballooning and did much to spread its virtues. Most of his efforts are known for their careful pre-planning; but one, at least, advanced the cause unwittingly. When asked "What good could a balloon be?" Franklin replied characteristically by asking "What good is a new-born baby?" This epigram spread quickly through certain circles in Germany, Poland and Russia and started scientific minds clicking.

Ascents were dangerous to the aeronauts. Lives were lost. Consequently Gustave Hermite and Georges Besancon began unmanned ballooning (*ballon sondes*) in late 1892 or 1893 to gain valuable meteorological data. This apparently was the first use of unmanned aerostats for science.

Today's high-altitude balloons hover for long periods at about 90,000 feet. Rockets, though they may go higher, are at altitude only for moments. Balloons have the a priori advantage. It has been said that "because the balloon is not going anywhere, it is so useful in finding out more about where it is."

Since aerostation was first Gallic, it is fitting that the Orion book was originally written in French, *Les Ballons*. Robert Delpire and Jacques Monory are responsible for the conception of the volume; Carter Mason, its translation. The more than 70 illustrations, some elegant color plates, were printed in France by Draeger Frères. Silver & Company Printers Corporation, a U. S. firm, printed the text.

The illustrations are generally from old engravings and line drawings, though some are very early photographs showing, for example, the nineteenth century's most famous aeronaut, Godard. Other pictures include such historic events as the *Hindenburg* burning at Lakehurst. The photographs themselves make the book worthwhile, but it would be a rare person indeed who would look at the pictures and not be inveigled into reading the text. And once that begins, it is difficult to put the book down until the last page is finished. Charles Dollfus is an expert, but he does not become bogged down in technical garble. There have been myriads of books written about aerostation, but this one captures the essence and presents it clearly and straight forwardly, at times with understated humor that is so typically French.

*The Orion Book of Balloons* is one of a series published by The Orion Press. Like the others, it is of odd shape, being 8½ inches long, but only 7½ inches high. The series began last fall when *The Orion Book of Time*, *The Orion Book of the Sun* and *The Orion Book of the Sky* were added to the house's list. Spring 1961 saw the publication of the present work and *The Orion Book of Evolution*. This October, *The Orion Book of The Written Word* was added and next in the series is *Volcanoes*. Although young in publishing years, The Orion Press has already established its list as being one of elegant books, beautifully conceived, accurate in detail and authoritative in authorship.

—*S.M.P.*

editorial

# Down Time

THE TWO WORDS making up the title above are unpopular because they mean equipment isn't making money. Frequently they can mean equipment is actually costing the firm that operates it a great deal more in cash, customer dissatisfaction and lost orders for the future than the simple cost of repair or replacement.

Ideally the perfect machine would be like the legendary buggy that wore out all at once and collapsed as a pile of dust. The chances of making such a machine are remote, and down time, it seems, will be with us as long as taxes.

Being philosophical and expecting down time, however, isn't the best answer to the frustrations it brings. A supervisory group has evolved whose major purpose is to do what can be done to eliminate down time, and to plan for the least possible disruption of profit-making operations resulting from what can't be eliminated. The most logical place to start is when buying equipment, and more and more "pay-out time" formulas include a weighting factor to bring in all costs over its life.

Another way of preventing down time is to use the proverbial stitch in time in the best tradition of preventive maintenance. Finally plans can be made after the fashion of the oil refinery turnaround described in this issue. The plant gets ahead of demand for a period estimated ample to inspect and overhaul all equipment, then shuts down to do the necessary work. It's still down time but costs are minimized and customers taken care of. The position of the plant in its market isn't jeopardized.

Even for the "put out the fire" type of maintenance that is so frustrating, planning can reduce the impact of the failure. Simply being prepared for contingencies through personnel training, careful record keeping and study of past machine performance and through the stocking of selected spares and necessary tools, down time can be controlled.

These theories or axioms of maintenance management are well established and where conscientiously and imaginatively applied have done a great deal to reduce and limit costs of both a direct and related nature.

Now, methods are coming under scrutiny. We are intrigued, but not surprised, at the growing number of pneumatic tools purchased exclusively for maintenance tasks. Some are large expensive ones that may be used only at intervals of months or years. Justifying such investments may seem difficult, yet cases are on record of tools costing several thousand dollars being paid for in the first few minutes of operation. Everything the tools have been used for since, as the saying goes, has been "gravy."

Pneumatic tool development for a time hinged largely on assembly line operations. The growth began with recognition of greater air tool speed and efficiency. Later, improved quality and uniformity of finished products were noted. The same general development has followed in maintenance uses. When an idle machine costs thousands of dollars per hour, even a few minutes saved are worth while. Quality of repair work has also to be reckoned with, because it does no good to fix equipment one day and have it fail again the next. Pneumatic tool speed makes it possible to check thoroughly the entire machine and still get it back on the line, correctly put together with proper torque values on fasteners, in less time than it would take to tear down only a portion with hand tools

Maintenance of construction equipment is one field that is rapidly developing the use of air tools. The machinery used is often large and rugged by the very nature of the jobs it must do. For the same reasons it requires lots of attention if it is to perform at maximum efficiency. And, with today's slim margins of profit, careful consideration must be given to actual repair costs as well as down time charges. Air tools can return their cost many times over in such circumstances if they are carefully selected and used.

Thus again we find that compressed air and the tools it powers are common denominators of all industry, from refineries to road building spreads, from steel-making plants to the mines that produce ore. A great deal of progress remains to be made. We are confident that as tighter control is gained over costs and quality, pneumatic tools will find an even larger role in keeping down time at a minimum.

# this & that

**No Funds For Iceberg Cowboys**

With the grave worldwide concern over the dwindling fresh water supply, it was refreshing to read in a recent issue of the *International Nickel Corrosion Reporter* of a bizarre scheme to supply water. Without trying to alarm taxpayers, we quote: "One proposal was to lasso icebergs in the Arctic seas, where they are not doing themselves or anyone else any good, and tow them south to points in more temperate zones where they could be chopped-up and melted-down for fresh water. This method if adopted may not be economically competitive with more conventional proposals, but it would add to the joy of newspapermen, and probably win us the Eskimo vote in the United Nations." After describing another proposal "to show the heights to which technical imaginations can soar in public when privately nursed for years," the article concluded with the comforting statement: "As neither the iceberg cowboys nor the salt guzzlers are slated for further development with public funds, we may never know just what their impact might have been."

★ ★ ★

**The Barrel Comes Home From The Sea**

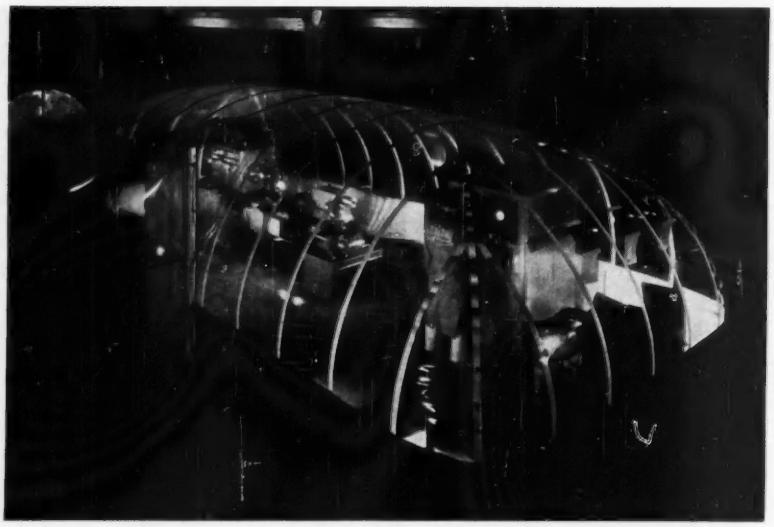
Roaming along coastal waterways where barges, floating docks and boat-houses abound, one can still see familiar metal barrel floats. These rusty symbols of life by the sea may soon be a thing of the past, for Cell-Foam, Inc., has developed a flotation device molded of expanded polystyrene foam reinforced with galvanized mesh wire. The "barrel" reportedly will support 480 pounds of dead weight, which is greater than that for the usual 55-gallon steel drum. More important, the functional life is several times longer because it does not deteriorate in water. Polystyrene will not absorb water and can never become water logged. The cell-foam barrel is 30 inches high and 24 inches in diameter. Molded around the perimeter, just beneath the skin surface, is 14-gauge galvanized steel 4x4-inch mesh wire. The barrel has been tested for more than a year in support service for more than twenty fishing barges. According to a company spokesman, there have been absolutely no ill effects. Another use might be as bouys for mooring and perimeter marking—simply thread a cable through its center.

★ ★ ★

**Sandy Atomic Shield**

Clean white "bar" sand and $^3/_4$ gravel from a quarry at Port Elizabeth, N. J., were singled out by nuclear physicists at the Bartol Research Foundation of the Franklin Institute to concoct a special concrete to shield their new atomic research laboratory, Springfield, Pa. The choice was made on the basis of the amount of natural radiation emitted by the materials. All soil, rocks, and sand are slightly radioactive, but rarely if ever do they radiate enough to be harmful to plants, animals or humans. Their radiation is intense enough, however, to affect some very sensitive experiments carried on at the Foundation. In some of these experiments, the random "background" radiation—rays finding their way into the lab from the soil beneath the floor, from wall and ceiling materials, from leaks through the walls from equipment in adjacent laboratories—can be ten times as strong as the radiations the scientists are trying to measure and record. This usually has meant that the experiment had to be stretched over a long period to give researchers enough data so they could separate the effect of the weak experimental radiation from the stronger background radiation. The process is similar to listening to a piece of music over the radio while it is almost completely drowned out by static. If you listen closely, for a long enough time, you are eventually able to detect the rhythm of the music.

With 1-foot-thick walls, floor and ceiling made from the special concrete mix, however, the background radiation is cut to about a sixth of that in other parts of the laboratory, making possible experiments that could not previously be performed. The cost of the special mix (one part Portland cement, two parts sand and three parts gravel), including extra freight and storage of the special sand and stone, runs about $30 per cubic yard, about twice the cost of standard, locally purchased concrete. But this is much lower than the cost of more commonly used shielding materials such as lead.



**A precision machine tool calls for new and ingenious manufacturing methods—this plastic bubble used by The R. K. LeBlond Machine Tool Company, Cincinnati, Ohio, for example. It is being used during runoff and inspection of its new Tape-Turn lathes. The bubble, held up by air pressure, is air conditioned and can maintain temperature within 5 degrees of setting at a time when shop temperature has varied as much as 25 degrees. It provides ideal conditions for bringing into balance the operating characteristics of the lathe and its tape control system. The structure is 12x25 feet, with a 9-foot headroom, has an air lock entrance, and a 10-ton air conditioner. It is attached to the floor by simple pipe cleats but can be moved easily from spot to spot.**

**Lightning's Lighter Side**

Lightning is usually associated with destroying life but in truth it also helps life flourish. Here is the reason why. Man and many other living things need plants as food. Plants need nitrogen, and although the gas makes up about 80 percent of air, plants can't use it in the gaseous form because it is insoluble in water. When lightning strikes, however, the intense heat causes nitrogen to combine with oxygen. The nitrogen oxides dissolve in rain to form dilute nitric acid that reacts with minerals in the earth to form nourishing nitrates. In this way ill-regarded lightning is actually the world's greatest fertilizer manufacturer, turning out an estimated 100,000,000 tons of fixed nitrogen a year. Some meteorologists also believe lightning aids cloud droplets to coalesce into raindrops thus helping plants to obtain their water as well.

**Skyscraping City—The New Zurich**

An artificial island in Lake Zurich will be constructed in Switzerland. It will have offices for 50,000 people and parking lots for 17,000 cars. It will consist of a cultural center with theaters, entertainment places and spacious public gardens facing the historic "Old Town" on both banks of the Limmat River; a business and shopping district with two rows of slender skyscrapers and shop-lined plazas; and a hotel town for 5000 guests with a panoramic view of the lake and distant mountain ranges. A 4-mile lakeside promenade would girdle the island on which pedestrians are to move freely without any perils from street traffic. The transportation problem, in fact, would be solved by confining all road and rail traffic to two underground levels that would be linked to the expressway and the inter-city road network in the Zurich area.

**Sand Hog Surgeons**

Dutch surgeons are experimenting with operations at three times normal atmospheric pressure —about 45 psia. Working inside a steel tank, the physicians seek to prolong the time heart surgery can be conducted. At a pressure of three atmospheres red blood cells and blood plasma can contain about twice the usual quantity of oxygen. If a patient's body temperature has been reduced as well, thereby lowering his need for oxygen, the high-pressure method will supply sufficient oxygen for 10 minutes or more. Many operations inside the heart can be completed in this short a period. The surgeons believe that the increased pressure will be helpful also in treating impaired brain circulation, toxic gas poisoning and other conditions. One problem, however, is that many doctors and nurses find the denser atmosphere uncomfortable and some can't tolerate it.

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# Compressed Air Oddities

*The Cushing pneumatic process of purifying alcoholic liquors was used around the turn of the century. Air, washed and purified by what was called "Professor Tyndall's well-known method," was compressed and forced through perforations that divided it into fine streams. The air agitated the liquor violently and permeated it. And, being warm, it oxidized the fusel oil and volatilized the light, poisonous ether, which was carried off. The liquor was left free of aldehydes. By this process, it was claimed, newly distilled stuff was made old in a hurry. While the liquid was intended for medical purposes and therefore for limited consumption, it was added that "the drinking of liquor treated thus does not cause stupefaction, headaches and other disagreeable results."*

The 26,600-ton World War I German battle cruiser *Derfflinger*, which was scuttled along with the rest of the Kaiser's war fleet on June 21, 1919, in Scapa Flow, off Scotland, was refloated, bottom-side up, in 1939 and kept afloat in that position for 7 years by pumping compressed air into the leaking hull. The reason was that World War II intervened about the time the British salvors, Metal Industries, Ltd., were ready to move the vessel where it could be broken up. Rather than let her sink again and lose the time and money that had gone into bringing her to the surface, the salvors preserved her buoyancy throughout the duration of the war. She was then towed to a yard equipped for reducing her to scrap and placed in a dry dock, where the task was completed in 1948. Actually, the ship floated upside down for 3 years longer than she served the German navy upright.

*In Berlin, Germany, in 1903, the slogan, "wire—don't write," operated in reverse, thanks to what was perhaps the world's best postal pneumatic tube system. It was so efficient that a letter or post card could be sent from one section of the city to another in less time than a telegram. The cost was 6 cents for a card, 7½ cents for a letter, while 12 cents postage would prepay an answer. The system was called the "Rohr post." Its offices in various parts of the city were identified by a red lamp.*

Cleaning carpets and clothing with compressed air was an accepted practice around the turn of the century and most large American cities had one or more establishments that specialized in performing that service. Among them was the Denver Compressed Air Cleaning Works, located in the Colorado capital. The firm maintained a stable of eight horses to make collections and deliveries, and proprietor, George J. Kindal, discovered by experimenting that the same cleaning system could be applied to the animals. The discharge from a compressor was routed through a brass coil placed in a metal drum containing hot water to insure that it would have a comfortable temperature. With a brush in one hand and an air spray nozzle in the other, a groom would go over a horse's body, first loosening the dirt and then blowing it off. After the animals got used to the hissing noise, they seemed to like the treatment, which left their coats clean and glossy.

*At the turn of the century, a London stationery house was selling a pneumatic letter-copy book. A copy book, as older readers may recall, was the carbon paper of half a century ago. A typed letter or one handwritten with indelible pencil was placed print side up in a large book of bound tissue paper sheets. One sheet was turned over on top of it and then a moistened piece of heavy cloth was laid on the tissue. The book was closed and put under pressure in a turn-screw press. After a few minutes the contents of the letter were transferred to the tissue and could be read through it from the reverse side.*

*In the London version, pneumatic pressure took the place of the mechanical screw. A thin, inflatable bag was placed in the book on top of the moistened cloth. The book was closed, clasped tightly shut and then the bag was pumped up with a detachable hand bulb. The even pressure reportedly produced clear copies.*

## Preventive Maintenance for Rock Drills

# II. Lubrication Practices

EXTREME HEAT and cold, clouds of dust and contaminated water help emphasize lubrication needs, the single greatest rock drill bugaboo. Another cause is the ceaseless pounding and heavy, pinpointed loads that a drill must endure. A rock drill oil is clearly put to a severe test; attention to a few rules of proper lubrication and handling can help keep a machine running properly.

A drill lube must, first of all, have several specific characteristics:

*High film strength* – To achieve this the oil must contain certain additives that resist breakdown. High film strength keeps wear low and temperatures down so cracking or burning of piston splines and rifle bar fluting won't develop.

*Correct viscosity* – Oil should flow freely and this depends on operating temperatures. Oil too heavy slows down valve action and drilling speed; thin lubricants don't protect against wear and can be washed away by water.

*Resistance to water washing* – Additives in the oil must help it adhere to metal despite water washing. Moisture in the compressed air must emulsify with the oil to form a continuous film for protection against acidic water.

*High oiliness* – Lubricity should be uniform at high and low temperatures.

*Low pour point* – Oil must remain fluid to feed through the line lubricator so it can be picked up by the air and distributed to drill parts.

*High flash point* – A high flash point prevents "dieseling"–smoking. Many drills develop high temperatures in the front head from the rapid compression of air. The oil must resist such heat.

*Nontoxic* – Oil should have no disagreeable odor even in confined areas. Quality oils contain materials to prevent nausea or eye irritation.

*Nonfogging* – In effect this means the oil must have high adhesiveness to metal. If not, the excess exhausted with the air will produce a disagreeable fog.

*Chemical stability* – The oil must resist oxidation so gummy residues that foul valves do not build up.

These characteristics pose a challenge but many established oil companies furnish a quality product tested and approved for rock drills. The companies' technical representatives can recommend the proper grade for unusual drilling conditions. Be sure to pick a reliable supplier and use only those lubricants specially made for rock drills.

### Application

The air line oiler automatically feeds a uniform spray of atomized lube into the air hose ahead of the drill. One should be used with every drill for it assures positive lubrication of all working parts. Such oilers are adjustable for rate of feed and require little attention except an occasional cleaning. A line oiler should be selected of sufficient capacity to supply the drill with ample lubrication for an entire shift. Drill makers recommend installing the oiler in the air hose not more than 10 or 12 feet from each drill. If farther away, oil droplets accumulate inside the hose and the lube is delivered intermittently. A higher rate of feed will be needed for good distribution and this procedure is unreliable and wasteful.

Regular attention is needed in servicing all lubricating devices. In the case of the line oiler, experience will tell the drill operator (or whoever is assigned this responsibility) the time interval between servicings. The period will vary according to the type of drill, whether drilling is wet or dry in continuous or intermittent use. Air line oilers must be adjusted to these conditions and presence of oil should always be checked at exhaust ports by placing a paper near them. Oil droplets should appear; excessive lubrication will produce fogging.

Sometimes hand oiling–pouring oil directly into the air inlet–is used on small nonrotators such as clay spades. This method is inefficient. Much oil is blown out the exhaust and the machine soon suffers. Again a line oiler should be employed.

A point easily overlooked is correct storage of oil. Even the best will fail if kept carelessly. Oil should be stored in covered containers in as dustless an area as possible. Before filling a drill reservoir or line oiler, wipe the filler plug clean. Oil often can also be packaged in convenient reusable quart cans less easily contaminated.

### Improper Lubrication Results

Poor lubrication in a rock drill immediately produces a faster rate of frictional wear. Sliding pressure between unoiled working parts scuffs metal and tears out tiny fragments. The real danger, however, is the heat generated. It creates tiny cracks that speed the destruction of the drill. These small openings lead to progressively larger fractures, metal fatigue sets in and the part finally breaks.

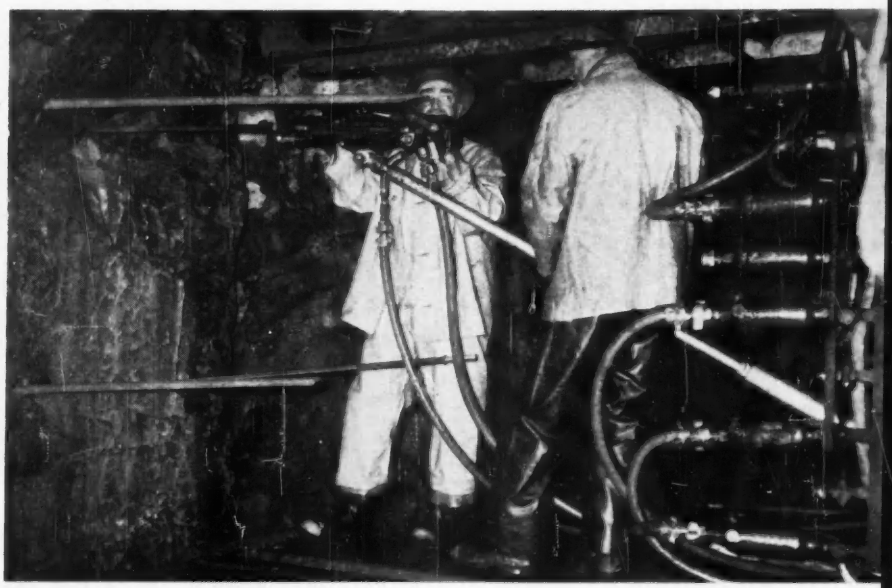
Moisture is another rock drill enemy and is present in the atmosphere about the drill and the air driving it. As mentioned, rust will form when an oil is used that does not emulsify well with water to provide a uniform coating. An oil that resists the washing action of water is mandatory. Also, water that enters the drill, either because of poor packing or because of excessive water pressure, exposes the tool to rust and corrosion. Corrosion pits finished surfaces and increases the danger of wear and metal fatigue; each condition accelerates the other.

Abrasive wear often occurs in a drill because rock dust and dirt enter and destroy close tolerances. Sluggishness results. Such abrasives can enlarge clearances to the point that piston blow-by slows drilling speed. Dust in the front head can expand clearances so that the cushion is lost and the drill must be immediately repaired, or will be seriously damaged.

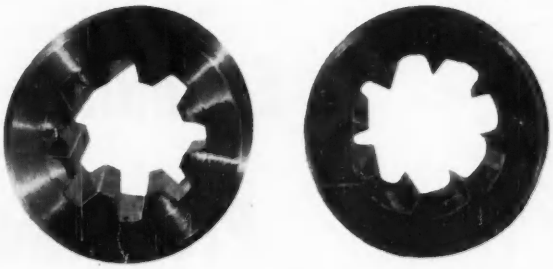
Impurities entering the drill through the air hose can be controlled by blowing out the line before coupling up, and by using air strainers. Abrasive wear is also hastened by dirty oil that distributes particles throughout the drill. Idle drills should have cloths stuffed into their openings so that no dust can enter. Oil storage containers should have tight closures to keep lubricants clean.

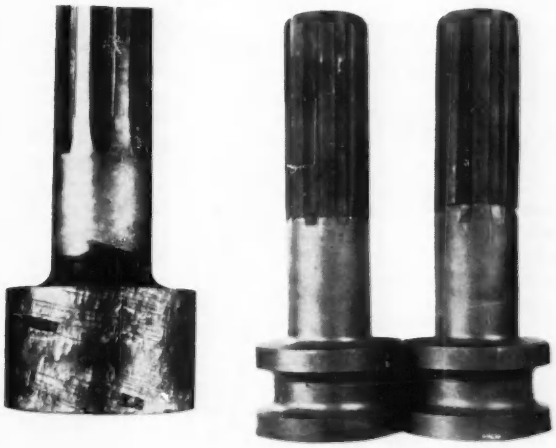
Before a drill is put in storage it should be protected from moisture. Clean the tool thoroughly, then cover all parts with a light rust-preventive oil. Small rock drills and nonrotators can be cleaned by soaking them completely in kerosene or Stoddard solvent for several hours. Gummy residue will be loosened and can be blown out with clean compressed air. After cleaning, pour a generous amount of rust-preventive oil in the drill and run it briefly to distribute the lubricant. Keep the tool in a clean, dry storage place. For extra protection it can be wrapped in a moistureproof bag.

To prepare larger drills and drifters for storage, dismantle them and soak all parts in a cleaning fluid to cut gummy matter. Clean parts should be liberally oiled and the reassembled drill should be kept in a clean dry area. Seal all openings to the drill with adhesive tape or with cloths.

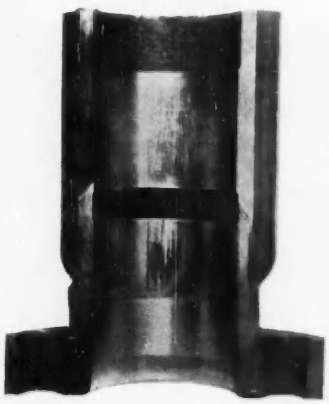


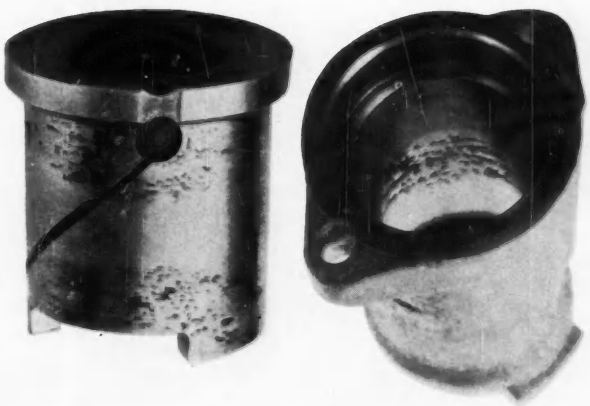
**LUBRICATORS** This installation of in-line lubricators for rock drill service has much to recommend it. They are installed just after the valves on a manifold that is part of the drill carriage, out of the way of drillers, and yet easily accessible for filling and adjustment.

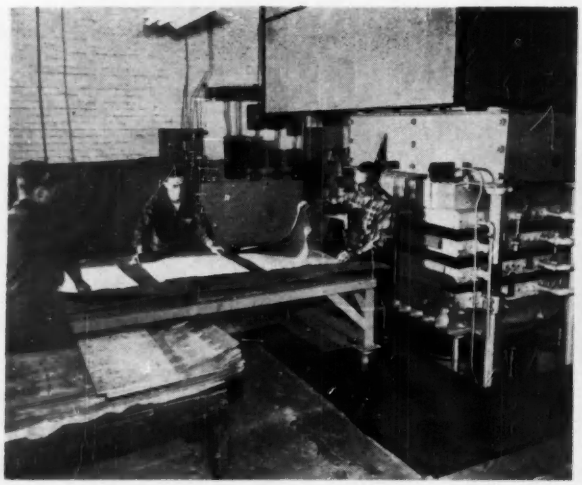


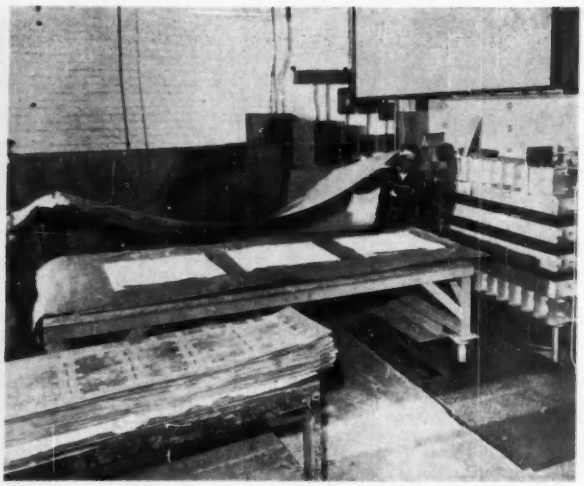


**LACK OF LUBE** These photographs of rock drill parts show some of the results of insufficient lubrication. In most cases frictional heat has caused cracks or checking, in others, spalling. At the left above are two rifle nuts. The one on the left is new, the other has been excessively worn through lack of oil. The three pistons at the right also were oil starved prior to failure. (The dark upper areas on the two at the right indicate acid etching to better show the cracks.) At the lower left is a section of a cylinder showing scoring from lack of lubrication, and at the right, front head parts suffering from the same mistreatment. Other parts of the drill can show equal or greater damage when run without oil.

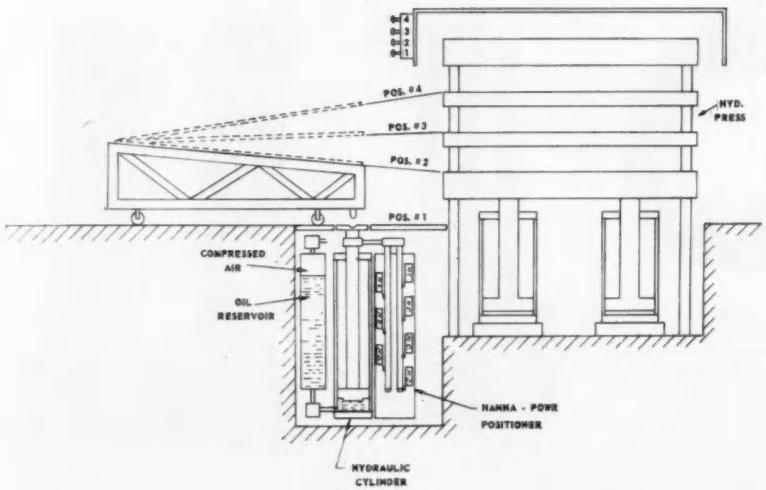


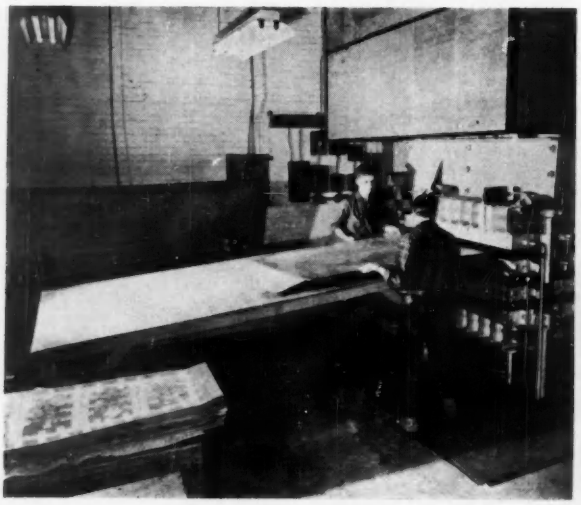


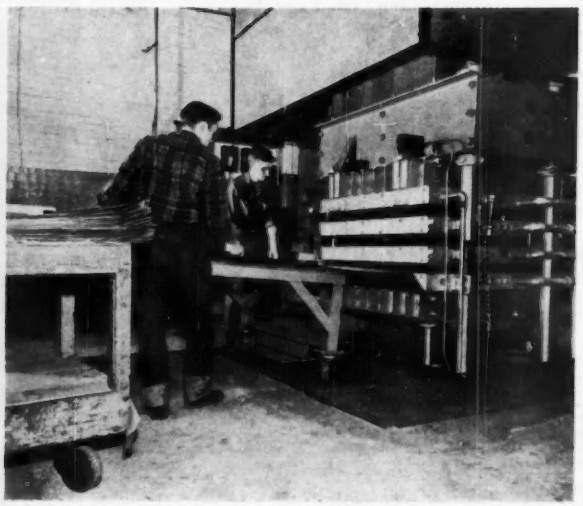




# Air / Hydraulic Control Expedites Production





# Process

ARTISTIC Veneers, Inc., a division of R. S. Bacon Veneers, Inc., was faced with a major production problem: to find a way to keep layers of fine, expensive veneer in close registration as it is made into sandwiches and handled prior to being placed in a steam-heated hydraulic forming press. The solution was found in a control device that utilizes compressed air operating a hydraulic cylinder.

These sandwiches of 2-ply veneer wood vary in size from 18 x 18 inches to 5 x 8 feet. They are assembled on a movable lay-up table next to a steam-heated press. The table is placed in front of the press, then a large 5 x 8-foot sheet of aluminum caul (a curved form for pressing veneer) is placed on the table. On the top of the caul goes a heavy canvas blanket, then a layer of $^1/_{28}$-inch-thick veneer. This is followed by a film glue and another layer of veneer (backing wood). The whole is covered with a second caul, making the 2-ply sandwich of veneer for, say, a table top. The pieces of veneer are often odd shapes, different sizes and with grain of the wood to be laminated running at cross angles. Therefore it is important to have an accurate registration between layers. All joints are assembled offset.

This lay-up process is illustrated at the top of the opposite page. Note how a portion of the floor plating in front of the press lifts the wheels of the lay-up platform to make the table level. Under this floor plate section is an automatic Hanna Powr-Positioner which has expedited production at Artistic. This device controls the hydraulic power cylinder which lifts the table to a level position (as well as three other heights). A 4-button switch in the black box on the press, shown at the right with its conduit line leading down into the floor, is the control mechanism.

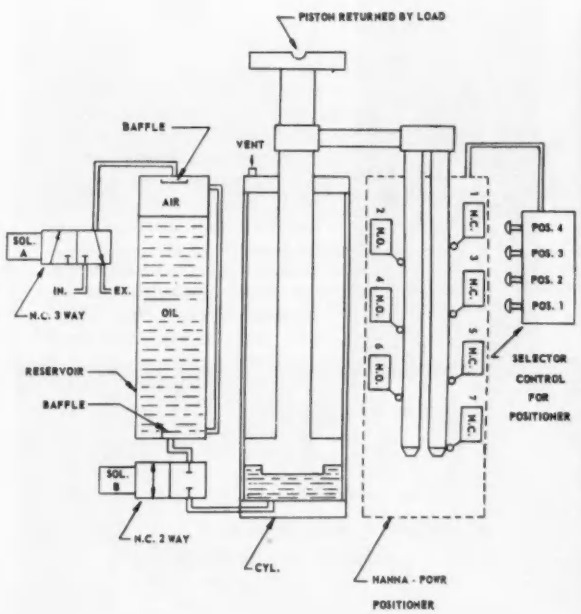
When three sandwiches have been assembled on the table, one operator presses the No. 2 button on the Powr-Positioner control box. This actuates the air-powered hydraulic cylinder, pushing the floor plate up so the table is in line with one of the three openings in the front of the press. Then one sandwich is slid into the press. (This is illustrated at the bottom of the opposite page and is diagrammed in the sketch above the pictures.)

The procedure is repeated moving the table in line with each of the other openings. Speed is essential if the sandwiches are to be put into the press before the glue sets. The automatic positioner hastens this loading operation, for all the operator must do is push the correct control button. The positioner is preregulated to each of four correct levels. No operator time is lost in aligning the table precisely. Trial and error is eliminated.

The Powr-Positioner, which is the key to this operation, is shown below with a $3^1/_4$ x 36-inch-stroke air-operated hydraulic cylinder. The positioner is attached to the power cylinder with the hydraulic oil/air reservoir, then fastened to the wall in an upright position (see sketch below). The cam rods of the positioner are fastened to the power cylinder piston rod. Thus as the positioner control box signal directs the power cylinder to lift up to, say, the top position (No. 4), the cam rods inside the Powr-Positioner housing pass all the switches below the No. 4 position, stopping in the null position between two position No. 4 switches.

Air pressure is supplied by the plant air system at 100 psig. Compressed air is directed into the top of the oil reservoir. A baffle keeps the air stream from churning and foaming the hydraulic fluid. Extreme accuracy is achieved by using air to operate the hydraulic cylinder. This combination is being used in increasing numbers of hydraulic cylinder applications. Engineers at Artistic Veneers decided to use compressed air as the source of power not only because of the accurate control it imparts, but because it was readily available in the plant for other uses—air clamping for holding veneer wood together while glue is applied to the edges, cleaning machines and keeping moisture from condensing on splicing machines. The compressor is rated at 165-psig pressure, working pressure is 105 psig. The air reservoir is 21 x 52 inches.

At the end of a production day, the Powr-Positioner is returned to full level by pushing the floor level button, thus making it possible to roll the lay-up table out of the way with no obstruction on the floor, as would be the case if a scissors-type lift mechanism were used.



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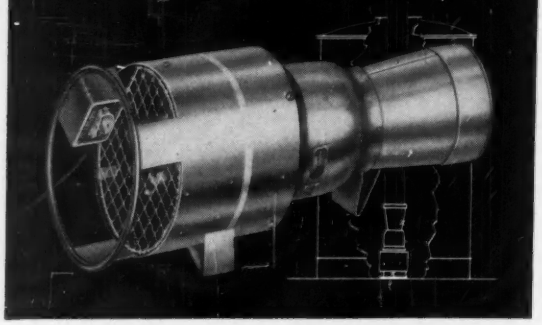

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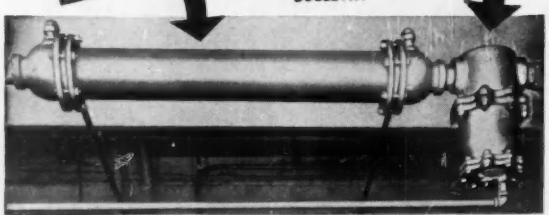

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# Hydrostatic Pressure Replaces Shrink Fitting

FINNED heat-transfer elements used in economizer sections of steam generators can be assembled by expansion with hydraulic pressure from a compact hydropneumatic pump. This unusual technique proved successful recently for a customer of a large metal fabricator.

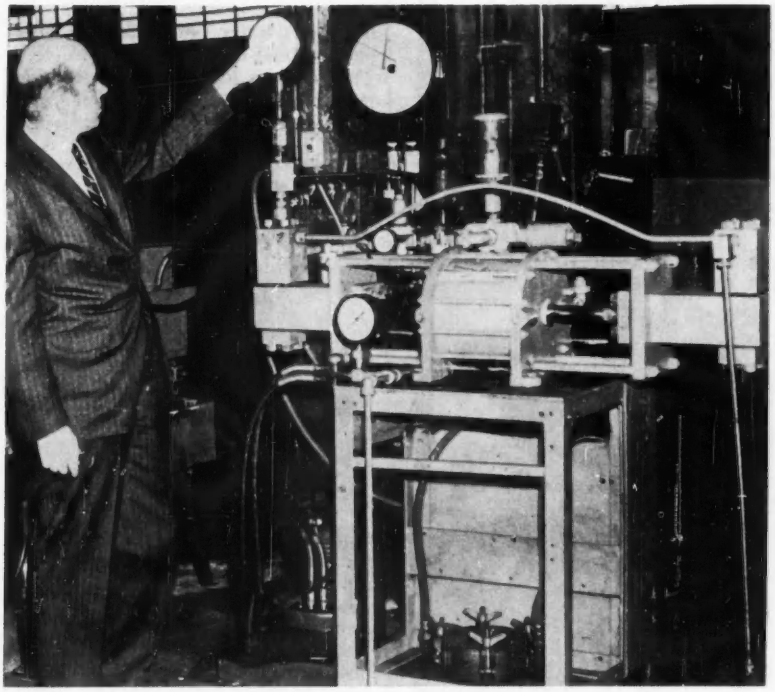
The elements consist of tubes covered with transfer fins, flared to provide separation. Tubes are SA-210 carbon seamless steel. They are somewhat longer than 29 feet, and have an outside diameter of 2¼ inches. Each tube has 691 cold-rolled carbon steel transfer fins, ⅛ inch thick and 6 inches square. Usually the fabricator fastens the fins to the tube individually. Heated cast rings with collars attached are positioned on the tube and shrunk in place with cold water. The trick is to get a tight fit between fins and the outside of the tube.

In the new technique, all 691 fins on the tube are assembled at one time. Then the tube's outside diameter is expanded to lock the fins in place. A highly efficient hydropneumatic pump, produced by Aldrich Pump Company, subsidiary of Ingersoll-Rand Company, provides the required pressure for the expansion.

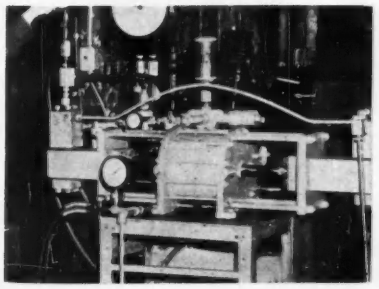
Here is how the job is done. Fins are positioned about ½ inch apart in a notched assembly fixture. The tube is then threaded through the fins and the assembly fixture side-locked to hold the fins in place. Next the top of the assembly fixture is placed on the fins for end seals and expansion pressures. End seals are locked to each end of the tube with hydro-jacks. The assembly is filled with water, and pressure is applied by the pump.

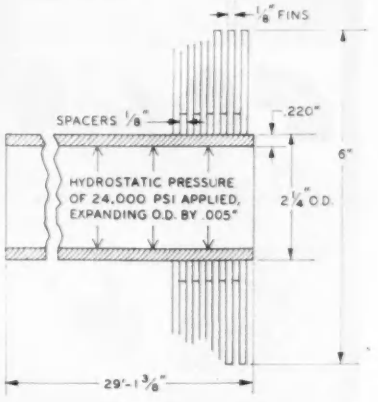
Operating on air line pressure of 80 psig, the pump exerts an initial pressure of 4000 psi to hold the end seals. Pressure is then raised to 24,000 psi, which expands the outside diameter of the tube the necessary 0.005 inch. Heat transfer fins are "frozen" in position. The internal pressures and time they were held is recorded.

The fabricator reports that the hydropneumatic pump provides accurate pressure with a minimum build-up time. Furthermore, the pump has been functioning smoothly with no reported down time or maintenance required.

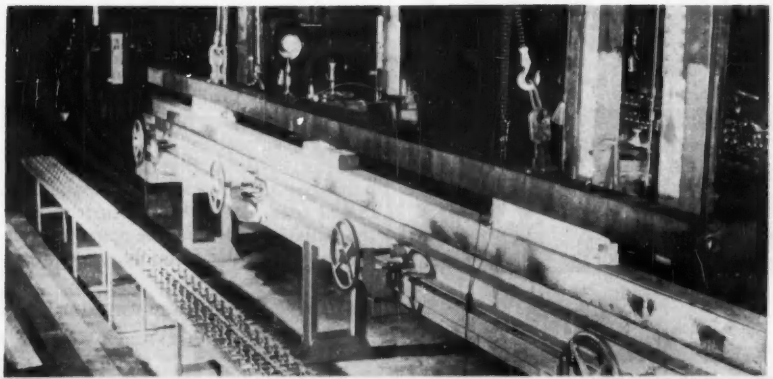


**RECORDING AND HYDROPNEUMATIC PUMP** Above, over-all view of hydrostatic pressures inside the tube being shown on indicating pressure gauge. A record of these pressures and the times they are applied is maintained. To the right of this picture is a clearer one of the Aldrich hydropneumatic pump.






**FINS POSITIONED** Heat-transfer fins shown positioned on carbon seamless tube, left. Application of 24,000 psi hydrostatic pressure expands the outside diameter of the tubing by 0.005 inch, permanently fastening the fins to the tube. Previously fins were shrunk into place individually. Above, diagram shows cross-section of a finned heat-transfer element.



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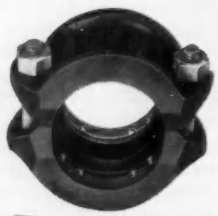

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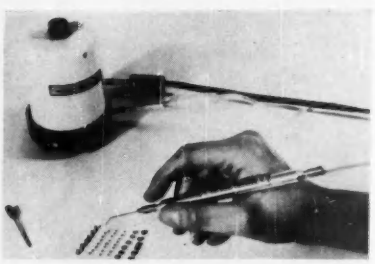


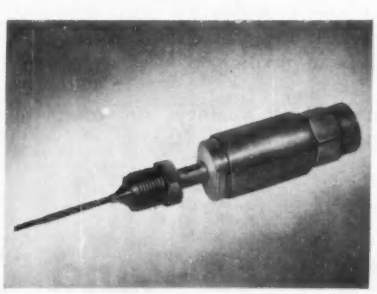
DO YOU want to simplify the selection of power cylinder accessories? A reference bulletin providing a method for quick identification of mounting accessories for square-type, industrial hydraulic and pneumatic power cylinders may be of help. Cylinder mounting accessories described and fully cataloged are the female rod clevis, female rod eye, clevis bracket, mounting plate and pivot pin. All that need be known about a particular cylinder is its bore and rod thread sizes. With this information and the bulletin, which may be yours without charge, the proper accessory, or set of ac-

# Industrial Notes

cessories, can be easily selected. All key dimensions are provided. *Hannifin Company*, Department 156, 501 S. Wolf Road, Des Plaines, Ill.

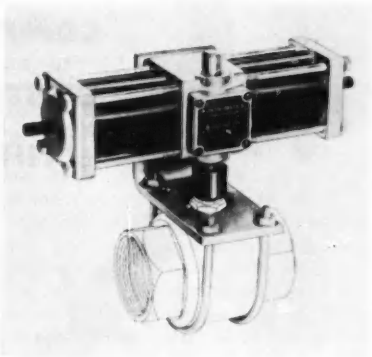
SAFE-T-KASE gauges provide exceptional viewer protection from explosive forces resulting from Bourdon tube rupture. An integrally cast solid wall in the gauge separates the Bourdon tube assembly from the ring, glass and dial. In addition, the glass itself is the safety type, which provides even greater protection for personnel. Full access to the Bourdon tube assembly and the movement allows easy inspection, repair or recalibration without removing the ring assembly or dial. Copies of a new bulletin describing Safe-T-Kase gauges may be obtained by writing to the advertising department of the company. *J. E. Lonergan Company*, 211 Race Street, Philadelphia 6, Pa.

UNIQUE thermocouple configuration has been designed for installation in a pipeline carrying polyethylene at high pressure. To minimize build-up of plastic on the couple when it is oriented in the same plane as the flow of material, the hot junction is shaped like a screwdriver tip. These units are tested by Trinity at 75,000 psig, and in the customer's application will operate at a pressure of approximately 50,000 psig. The miniature assemblies utilize a $^1/_8$-inch O. D. sheathed element called Trinox, which contains 30-gauge thermocouple wire. To prevent the thermo-



couple from being ejected at high pressure, the Trinox is swaged from $^1/_8$- to $^3/_{32}$-inch O. D. so as to fit against a shoulder inside the adapter. The couple is seal-welded to the outside of the adapter. While these units have been custom-designed for a specific customer application, the basic components are standard. Additional information may be obtained by writing to the manufacturer. *Trinity Equipment Corporation*, Cortland, N. Y.

REMOTELY controlled, pneumatic valve actuators that can be installed on quarter-turn valves of any type, make or size, are adaptable to all ball, plug and butterfly valves operating through 90 degrees. They are designed "to bring a new degree of efficiency and versatility to the valve actuator field." Produced in four models, the units can be easily assembled on the spot because bolts and the stem adaptor of each are made precisely for the valve on which the actuator will be installed. There are no special tools needed. Models span a wide range of torque ratings—100, 260, 825 and 2050 inch-pounds—which permits selection of the proper actuator for a specific job. Lubricated and sealed at the factory, they are said to require no maintenance, and their close-coupled construction and central mounting results in minimum space requirements.



Each unit is self-contained with no external actuating levers or swiveling cylinders. This increases the safety factor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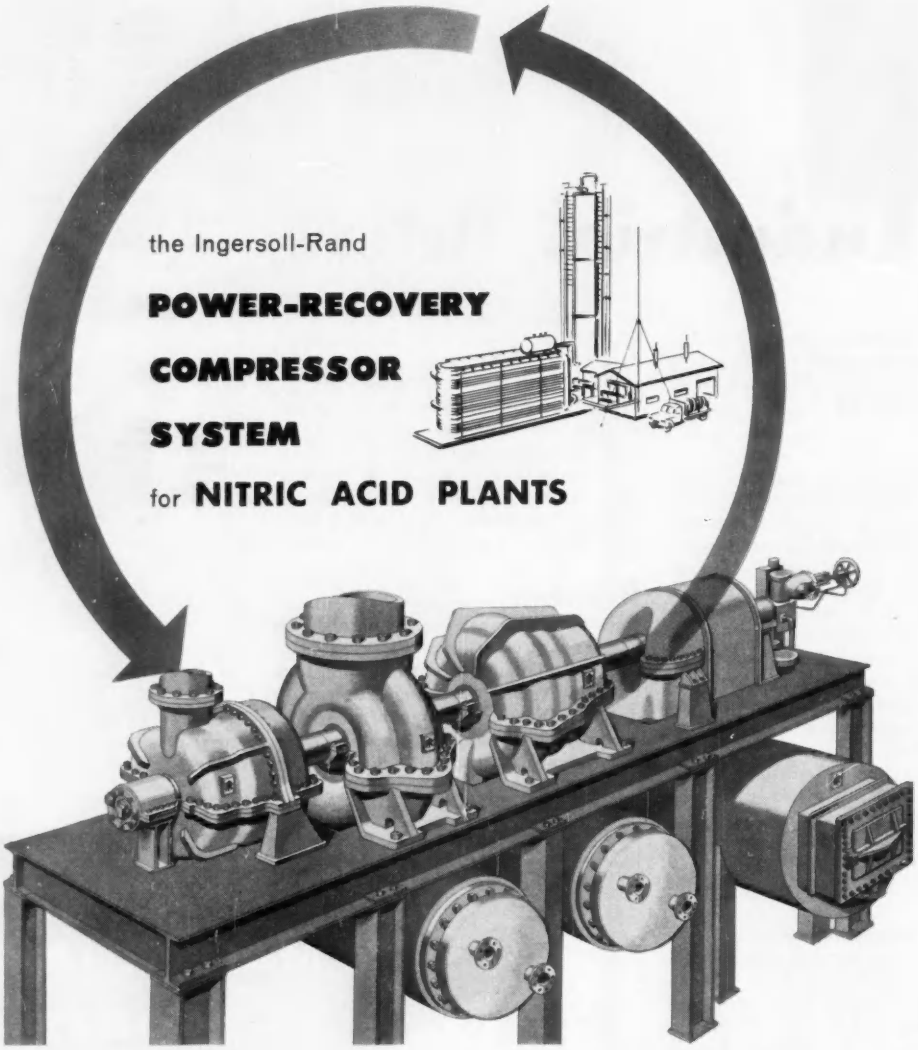


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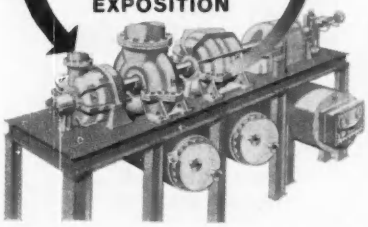

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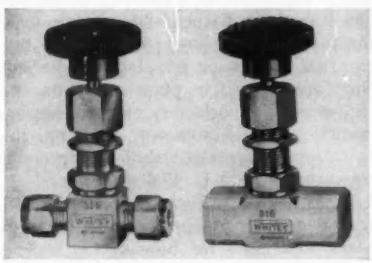
and eliminates risk of interference with other installations. Nylock set screws at each end of the actuator cylinder allow the precise adjustment to full-open and full-closed position of the valve, compensating for wear and backlash in the valve's stem engagement. *Contromatics Corporation*, 67 West Street, Rockville, Conn.

SCREWED-BONNET, bar-stock valves for $^1/_8$- and $^1/_4$-inch tube and pipe connections are available from Whitey Research. The No. 2 Series units, as they are termed, are fabricated of 316 stainless and Monel. They are compact and are recommended for instrumentation or any application where leakproof on-off control is essential. The buyer has a choice of Swagelok tube fitting connec-



tions, or female pipe thread connections on straight and angle pattern styles. The valves can also be ordered with Swagelok inlets, female pipe outlets or female pipe inlets to Swagelok outlets. Panel mounting, Teflon cylinder packing, micro-regulating and nonregulating stems are standard features. Colored handles, to permit color coding, can be specified. *Whitey Research Tool Company*, 5525 Marshall Street, Oakland 8, Calif.

CORROSION is always a problem. Different metals suited to resist this destructive action are given a thorough review in *Harper Corrosion Guide*, a 24-page illustrated brochure. Written to help manufacturers build corrosion resistance into their products and properties, the guide analyzes the seven basic types of corrosion and shows what specific metals best resist them. These include brass, naval bronze, silicon bronze, nickel and high-nickel alloys, stainless steels, aluminum, copper, Monel metals and high-temperature alloys. A chart lists 136 types of corrosive agents that may trouble engineers and maintenance people, and shows how eight types of metals resist each. For example, according to the chart, brass and naval bronze are "no good" for resisting potassium hydroxide and silicon bronze offers "fair" resistance, whereas Monel and eight basic stainless steels are "excellent" for resisting this agent. Another chart, particularly valuable for specifying metal fasteners, is a cross index of chemically equivalent specifications of metal fasteners, giving the commerical names, Harper alloy numbers, method of manufacture, American Society of Testing Materials specification, Military specification, and federal (QQ) specifications. *The H. M. Harper Company*, Morton Grove, Ill.

ANACONDA 707 Heat Exchanger Tube is an Anaconda American Brass Company development having mechanical properties approaching those of more expensive metals previously available for feedwater heater tube service. The alloy is being marketed in the annealed state permitting close U-bends, and has a maximum allowable stress value in tension of 15,200 psi at 600° F. This exceeds stress values of other recognized but more expensive metals and alloys.

Anaconda's 707 heat exchanger tubes have a copper-nickel-iron-manganese composition and a melting point of 1250° C. Typical tensile strengths are quoted at 84,700 psi for $^5/_8$-inch O.D. tube (0.049-inch wall) and 88,000 psi for a $^3/_4$-inch one (also a 0.049-inch wall thickness).

The new product can be welded satisfactorily into steel tube sheets of feedwater heaters with procedures the same as those previously used for installing other copper-nickel alloys. The product is said to have high resistance to corrosion by sea water even at relatively high velocities. The material has been submitted to the ASME Boiler and Pressure Vessel Code Committee for approval.

FLO-GARD is a cleanable strainer for applications as a sump or in-line on all types of lube and cutting oils, coolants, hydraulic oils, water, aqueous bases and synthetics. Because there are no bolts, nuts or screws used in its construction, assembly of the unit is fast and easy. No

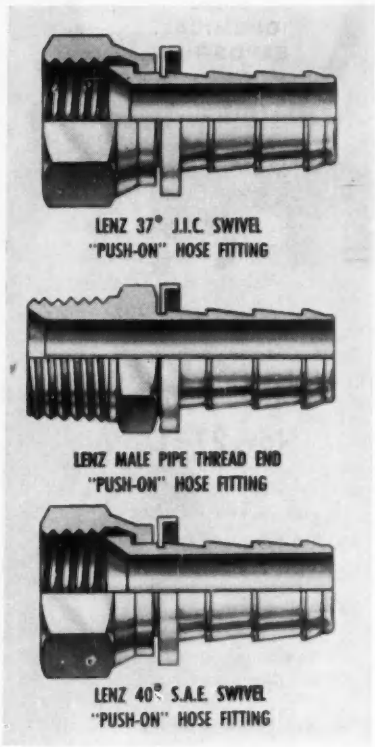
**"Thanks Smith, sorry there fella."**

tools are required for installation. Instead, it is recommended that Flo-Gard units be hand-tightened. The strainer employs corrosion-proof Delrin end caps bonded by an epoxy to Monel screen and centertube. No dissimilar connections assure longer service life. The solid, full-welded seam of the convoluted

screen is said to guarantee uniform filtration. Flo-Gard is one of the new products from a recently formed Industrial Division of Warner Lewis Company, a Fram Corporation subsidiary since 1954. It is charged with the development of a complete product line of industrial filters to handle both liquid and gas. *Warner Lewis Company,* Tulsa, Okla.

MACHINING aluminum often brings forth a number of questions. Those most often asked are answered in a Reynolds Metals Company brochure. The publication covers speeds used for machining aluminum on screw machines, alloys with the best machinability, recommended coolant-lubricants, and information about tool materials and angles. *Reynolds Metals Company,* Dept. PRF-49, Richmond, Va.

PUSH-ON hose fittings and assemblies designed for practical, time-saving applications in conveying air, water, oil and petroleum-base fluids at pressures to 250 psig, have barbed systems that lock the fitting in the hose without need for external clamps or ferrules. These fittings are utilized in plant maintenance, in pneumatic machinery, in farm implements, and in automotive, welding, lubrication and service shop equipment. Featured are S.A.E. 45-degree swivel, J.I.C. 37-degree swivel and male pipe thread end fittings in a complete range of popular sizes for hose of $^1/_4$ to $^3/_4$ inch i.d., according to the catalog that is now available. Assemblies may be obtained in seamless, single fabric braid hose with snythetic inner liner and braiding that provides proper flexibility and strength. Hose is available in a choice of oil- and mildew-resistant cotton, or abrasion-resistant rubber covers. The Lenz swivel-type Push-On fittings




are constructed of brass with cadmium-plated steel nuts. Male Push-On fittings are all brass. The hose is compounded for temperatures of −40° to +250° F when used with most fluids. *The Lenz Company,* Dayton 1, Ohio.

DESIGNS in rubber seat butterfly valves, from 3 to 144 inches in diameter and for pressures from vacuum to 150 psig, are described in Bulletin No. 6. Dimensions are included. *Henry Pratt Company,* 319 W. Van Buren Street, Chicago 7, Ill.

STAINLESS steel or rolled brass pulsation dampeners for pressure gauges are announced by Kunkle Valve Company. They are for use on pumps, compressors or other pulsation-producing air, gas or liquid-handling units within a limit of 10,000 psig operating pressure. Claimed to effectively smooth out pulsation and reduce gauge flutter, the dampeners guard against excessive wear or destruction of gauge mechanisms, and maintain calibration accuracy. Each device utilizes a variable orifice that permits full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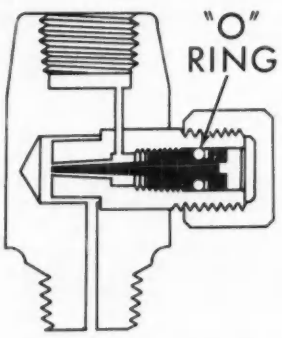
pressure measurement, but prevents surge or shock by throttling abrupt pressure changes of large or small amplitude.




The variable orifice may be externally adjusted without line or gauge disconnection, and a hex cap protects adjustment against inadvertent change. Specification sheets are available on request. *Kunkle Valve Company*, 121 S. Clinton Street, Fort Wayne, Ind.

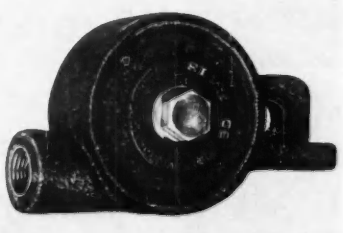
**PORO-PAC** filters have been developed to provide industry with micronic filtration systems that reportedly remove contaminants to 5 microns from all liquids and gases. Corrosion-resistant brass

cases; porous metal sintered bronze, ductile shockproof elements that are easily cleaned and require no replacement; and operating temperatures of −400° to 900° F are features. All cases are rated for 250-psig pressure and are completely sealed with O rings. *Pacific Sintered Metal Company*, 8333 Hindry Avenue, Los Angeles 45, Calif.

**CENTRALIZED** lubrication equipment is covered in Catalog 82. Featured in the 32-page booklet is Lincoln's complete line of lubricant application equipment with descriptions of fully automatic, semiautomatic and manual methods of operation. High- and low-pressure lubricant injectors, timing and alarm controls, and filler pumps are discussed along with several installation accessories, such as tees, hose, flexible feed lines, and coupling studs, *Lincoln Engineering Company*, Division of The McNeil Machine & Engineering Company, 4010 Goodfellow Boulevard, St. Louis 20, Mo.

**ROLL-TYPE** air cleaners that reportedly will operate efficiently anywhere have been designated Roll-Kleen Model H-5 ("H" for horizontal media movement; "5," the fifth in this series). The H-5 is available with either automatic—that is, motorized and controlled operation—or manual drives, with or without media covers on either or both ends. The unit is manufactured in 84 standard sizes. These features, plus the reduction in the number of moving parts and a simplified method of media loading make the H-5 well-suited for use with the latest model air handling devices. The H-5 is designed for installation in a variety of positions, regardless of the direction of air flow. Media movement can be in either direction. Where headroom or vertical clearance is at a premium, the Roll-Kleen can be directly attached in ducts. *Farr Company*, P. O. Box 90187, Airport Station, Los Angeles 45, Calif.

**MINIATURE** lightweight vibrator—the 7 1/2-ounce BD-13—has great power and ruggedness. In spite of its size—about that of a pack of Pall Mall's—it will handle up to 10-cubic-foot-capacity bins, it is reported, bringing powdered, particulate or crystalline materials out of hoppers, down chutes and through screens. Silent operation is inherent. The BD-13 is fitted with a replaceable jet for greater air economy. Maximum air consumption is 6 cfm (free air at 80-psig pressure), declining as the requirement for high-speed operation drops and air pressure is reduced. It will operate on as little as 5-psig air pressure. A chrome steel ball, the only moving



part, is driven in an orbit on replaceable raceways of hardened high-alloy

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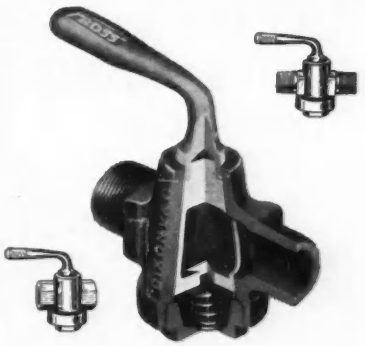

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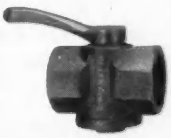
**Require no packing. Bronze plug firmly seated by spring tension against harder metal of valve body is automatically honed to perfect seat as handle is turned. Straight, full-flow opening through valve body and plug provides greater capacity with no friction loss. Valve opens or closes by quarter turn of handle.**

**In sizes ¾" to 1½" valve stem and handle are combined in one-piece forged steel unit anchored to bronze plug within valve body. Eliminates stem and handle breakage. Sizes ¼", ⅜", ½", 2", 2½" and 3" have externally riveted handles.**



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steel. This produces infinitely controllable frequencies from 0 to 22,000 cycles per minute. The lug design permits mounting in any position with a single bolt. *Martin Engineering Company*, Neponset, Ill.

## Books . . .

*Evaporative Cooling of Circulating Waters* (published by Pergamon Press, Inc., 122 E. Fifty-Fifth Street, New York 22, N. Y.) discusses the theoretical principles and methods of the evaporative cooling of water in ponds, spray tanks and coolers. The first part deals with the problems of heat transfer and mass transfer during evaporative cooling, the theory of coolers, and some of the problems of the hydraulics of coolers; the second describes the design of coolers for circulating water, methods of calculating their cooling capacity, and the main principles of their use. The volume was authored by L. D. Berman, State Power Publishing House, Moscow. It was edited by H. Sawistowski, Department of Chemical Engineering, Imperial College, London. The extensive development of heavy industry in the Soviet Union has necessitated a thorough investigation into the various ways of transfering heat from production plant. Soviet engineers have found the greatest advantage comes from the use of evaporative cooling of circulating waters. The equipment used for the evaporative cooling of waters differs from the numerous types of heat exchangers through the nature of the process taking place in them, which is accompanied by the transfer of material, and varies considerably in individual designs and conditions of operation. Considerable work has been done in the U.S.S.R. to study the operation of these installations and to improve their design and efficiency. Translated from the Russian second revised and enlarged edition, this volume gives a systematic account of the basic problems of the theory, design and use of coolers. 400 pages. Cost, $20.

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Absolutely tight, highly flexible, really rugged . . . Anaconda metal hose can be depended on for long, maintenance-free service. It's the leading choice in compressed air applications, because it will take punishment, control vibration and compensate for expansion and contraction.

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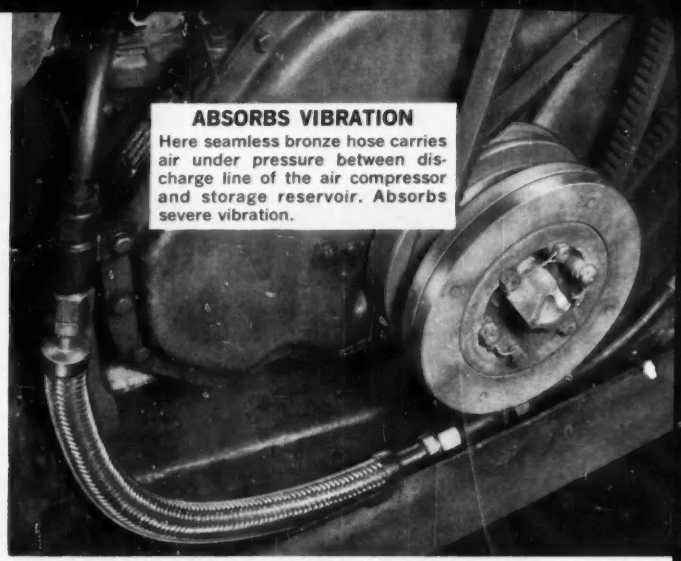

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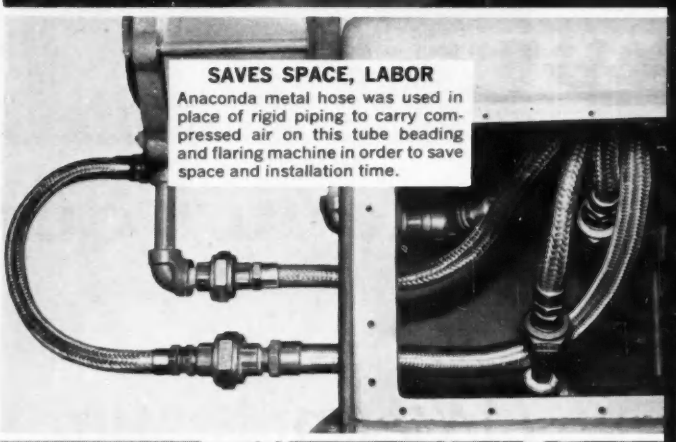
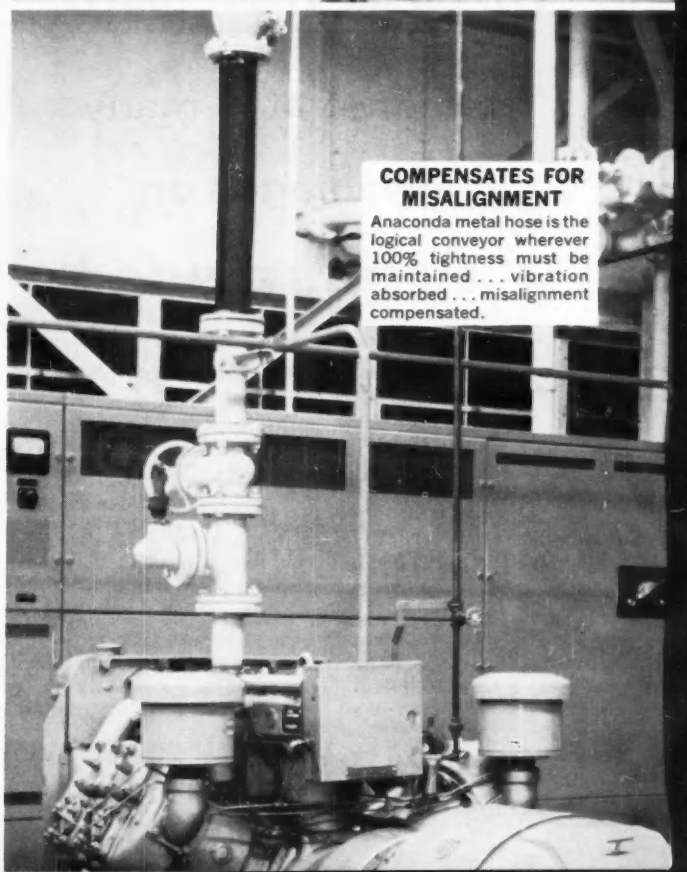
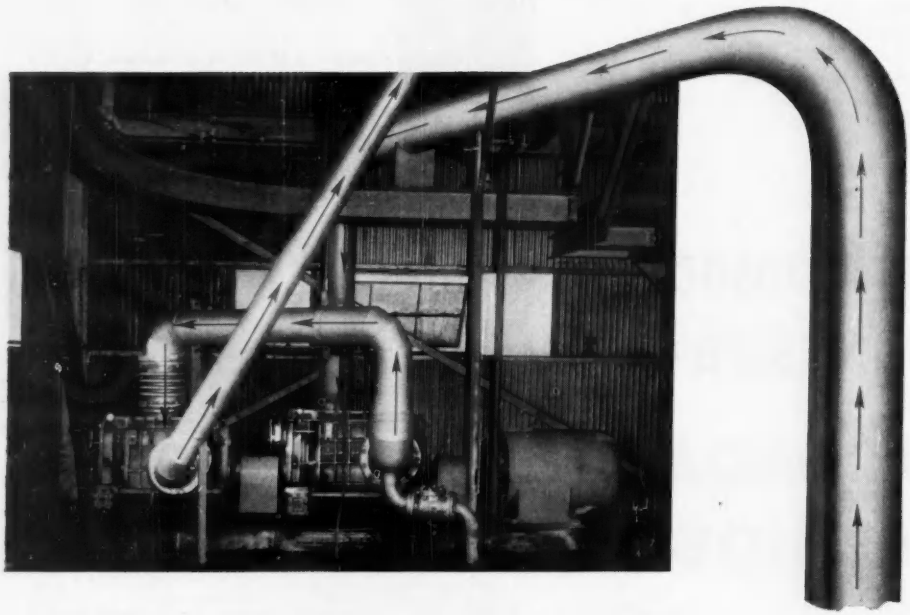
Here seamless bronze hose carries air under pressure between discharge line of the air compressor and storage reservoir. Absorbs severe vibration.



**SAVES SPACE, LABOR**
Anaconda metal hose was used in place of rigid piping to carry compressed air on this tube beading and flaring machine in order to save space and installation time.



**COMPENSATES FOR MISALIGNMENT**
Anaconda metal hose is the logical conveyor wherever 100% tightness must be maintained . . . vibration absorbed . . . misalignment compensated.



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## demonstrates many advantages on

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At the O'Donnell #2 coal-cleaning plant of the Rochester and Pittsburgh Coal Co. in Gilmer County, W. Va., an Ingersoll-Rand two-stage Axi-compressor has solved two problems frequently encountered in vacuum filter service.

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The Axi-compressor shown above easily met all vacuum requirements. This two-stage unit produces a steady vacuum of 24" hg at the suction inlet, and still has ample reserve capacity.

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It means that all the advances of the past, present and future can be applied to *every* GM Diesel—whether it's in equipment you've had for 20 years, or one that's just off the line.

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Detroit Diesel Engine Division, General Motors, Detroit 28, Michigan. (In Canada: General Motors Diesel Limited, London, Ontario.)

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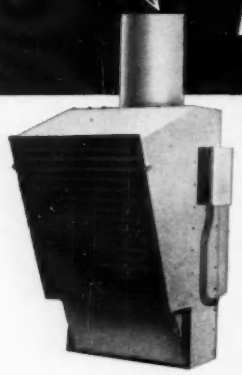
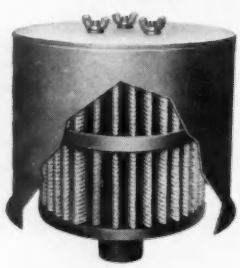
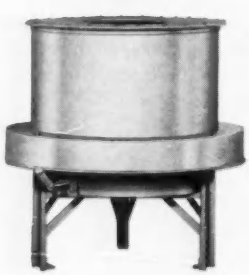


**AIR-MAZE AUTOMAZE**—the automatic, self-cleaning impingement type filter for heavy-duty use. A constantly moving curtain of viscous-coated double filter panels traps air-borne particles. Panels are thoroughly cleaned and recoated by passing through an adhesive bath. Filters consist of layers of crimped galvanized steel wire screens of selected meshes. Available in all capacities with or without weather louvres or plenums. Air or electric drive optional.



**AIR-MAZE "DA" DRY-TYPE FILTER**—laboratory tested for better than 98% efficiency with particles of 2 micron mean diameter, practically 100% with particles 5 microns or larger. Corrosion resistant, designed for use up to 6650 cfm. Filter media is heavy, deep-pleated wool felt flanked by sturdy galvanized steel cloth. Element can be cleaned with a commercial solvent or by blowing off with compressed air.



**AIR-MAZE OIL BATH FILTER**—the low-pressure-loss way to oil wash intake air. Offers a distinct engineering advancement because it provides low static pressure drop without requiring any outside energy. Removes practically all fine abrasives and dirt! No moving parts, nothing to wear out, easier servicing! Made of rugged, heavy gauge steel coated with enamel. Available in capacities up to 20,000 cfm.

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A total of 66 giant steel frames support the upper deck and roof of the circular stadium. An unusually long reach was needed for erecting the steel-plate assemblies which weighed as much as 70 tons. They used a stiffleg derrick with a 90-ft boom and 15-ft jib, working with an 80-ton-capacity crawler crane equipped with a 140-ft boom and 30-ft jib.

The stiffleg was rigged throughout with Bethlehem 6 x 25 Purple Strand, with fiber core. Crane hoist lines were the same.

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3 checks system efficiency
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5 plans for future

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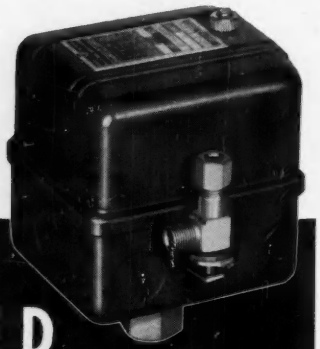

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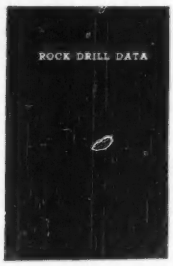


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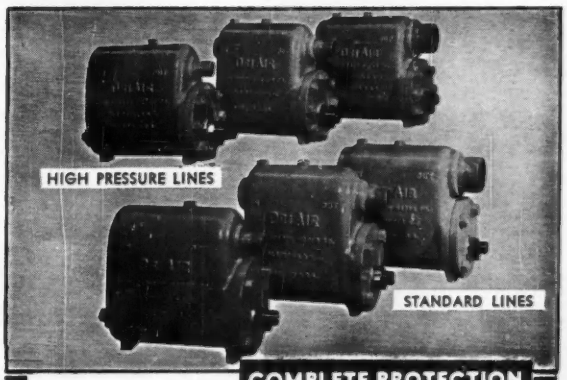


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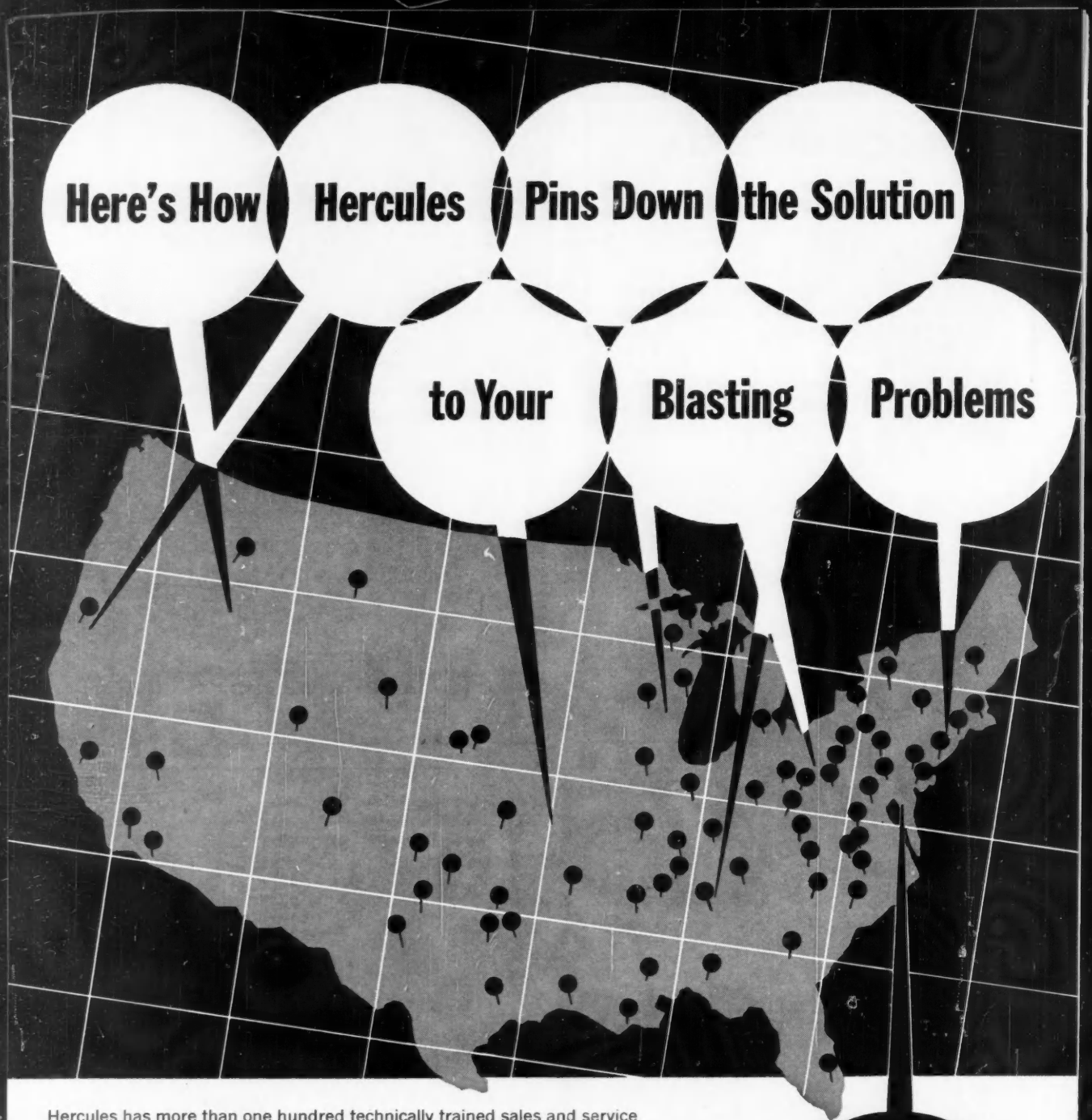


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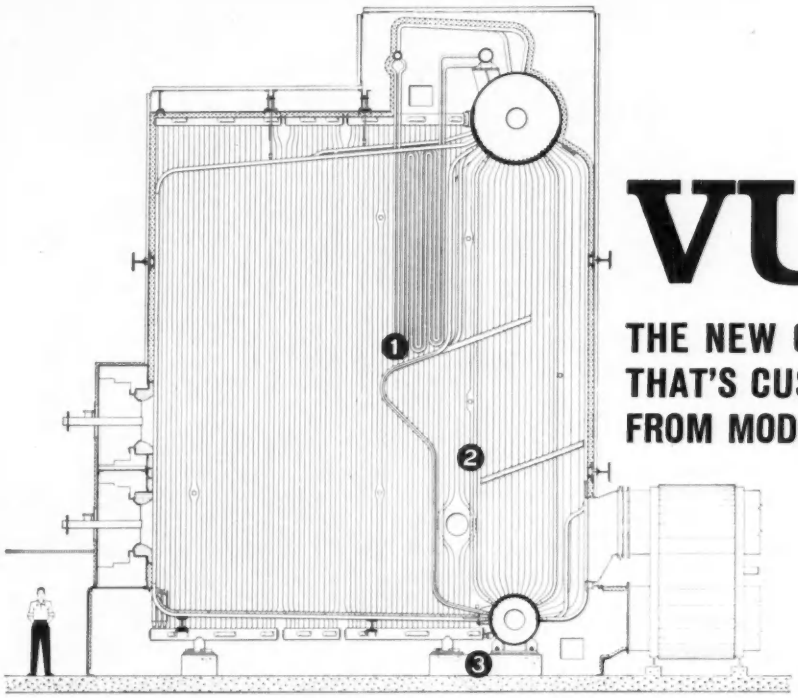



# VU-60

## THE NEW C-E BOILER THAT'S CUSTOM-DESIGNED FROM MODULAR COMPONENTS

**1** The VU-60 can operate over a wide load range while maintaining superheated steam temperatures close to the design point.

**2** Cross-flow baffling and symmetrical boiler bank assure low draft loss, eliminating sluggish flow in any pass.

**3** Only a simple reinforced-concrete slab is required. No conventional roller supports are needed.

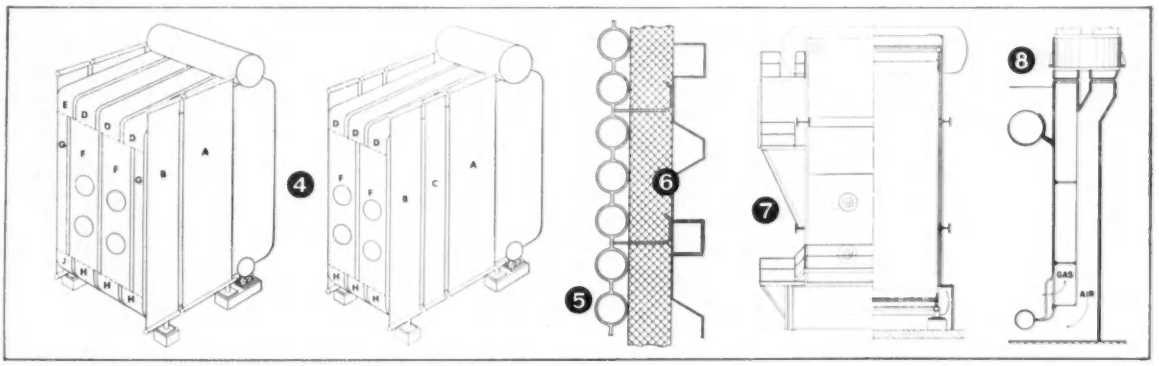
**4** Modular components allow proportioning of boiler for best combustion, heat absorption and gas flow—even where space problems exist.

**5** The VU-60 is an all-welded, pressure-tight envelope composed of modular panels of finned tubes. Minimum field welding cuts erection time.

**6** Insulation and pre-formed lagging are applied directly over tube panels. This reduces nonworking weight per pound of steam generated.

**7** Front elevation shows simplicity of platform arrangements. Platforms are attached to the boiler itself, minimizing the need for additional supports.

**8** Where top outlet is desired, air preheater may be located above unit, as illustrated.




## VU-60 SPECIFICATIONS

| | |
|---|---|
| Capacities: | 100,000 to 250,000 lb/hr |
| Design pressures: | 250, 500, 750, 1040 psi |
| Steam temperatures: | to 900F |
| Fuels: | Oil and/or gas |
| Firing: | Horizontal (front wall) or tangential |
| Size increments: | Depth—twelve<br>Width—eight<br>Height—three |
| Steam drum sizes: | Four |

The VU-60 can be designed to meet your most exacting steam needs. It's easy to install, economical and reliable in operation, completely accessible and functional. Get full information on how this new concept can fulfill your specialized requirements.

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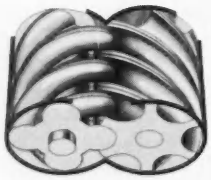
# 1200-cfm SINGLE-ENGINE PORTABLE COMPRESSORS

## *. . . performance-proved on the job!*



The SPIRO-FLO uses a radically improved method of *cycloidal compression* in which these two perfectly balanced rotors are the *only* moving parts.

The Ingersoll-Rand SPIRO-FLO – the world's *first* 1200-cfm single-engine portable air compressor – has already proved its stamina and dependability on a wide range of heavy-duty construction jobs. No bigger than a 900-cfm machine and actually weighing 1000 pounds *less*, the SPIRO-FLO does the work of two or more compressors with important savings in space, weight and cost. Ask your local Ingersoll-Rand representative or distributor for complete information.

**Ingersoll-Rand**

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*THE WORLD'S MOST COMPREHENSIVE COMPRESSOR EXPERIENCE*